APPENDIX A

Columbia Slough
Sediment Quality Evaluation

Columbia Slough Meandering Channel/Wetland Benches Project

Fact Sheet

Project Purpose

Creation of a meandering channel over various segments of a 10-mile stretch of the mainstem of the Middle and Upper Columbia Slough. The intended function of the channel deepening is to increase velocities to improve water quality during the low flow season and to provide wildlife and wetland habitat.

Project Description

The U.S Corps of Engineers is conducting a General Investigation (GI) Feasibility Study to evaluate a meandering channel in the Slough mainstem for water quality, wildlife and wetland enhancement benefits. Dredging would be conducted to an elevation of approximately 3 feet and the dredged material would be used to create wetland benches. These benches would be vegetated to support wildlife. Side casting would be used to create the meanders during low-water periods. The Multnomah County Drainage District (MCDD) which is responsible for maintaining the Slough channels would obtain the required 404/401 permits for conducting this project.

Project Background

Historical Chemistry Data Review

Historical data were reviewed to evaluate potential sediment issues related to inwater disposal (side casting) of Slough sediments. Numerous surface samples have been taken in the Slough mainstem on various dates and numerous locations. Most of the analyses were below the screening levels (SLs) of the regional Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF). Table 1 shows the exceedances of the SLs. Those analyses exceeding the SLs were 4 heavy metals, 3 phenol groups, 2 phthalate groups, 1 alcohol and 1 pesticide.

Sediment Sampling

After review of these data, the U.S Corps of Engineers conducted additional sampling to characterize the sediment of portions of the middle and upper Columbia Slough mainstem.

The US Army Corps of Engineers, Portland District personnel collected gravity core samples on May 18-19, 1999. The study area was divided into 8 sampling areas (see attached figure). The eight sampling composite areas were selected to give balanced coverage to the full-length study. Twenty-two individual cores were collected and composited with 3 samples per area (except area 7, one sample only). The eight composite core samples were divided, with the top representing the dredging prism and the bottom 6" to 12", representing the "newly exposed surface" after dredging is completed. Samples were analyzed for the following:

- Physical and Volatile Solids
- Metals and Total Organic Carbon (TOC)
- Pesticide/PCBs, Phenols, Phthalates and Misc. Extractables

- Polynuclear Aromatic Hydrocarbons (PAHs)

With few exceptions, the newly exposed surface has chemicals of concern at lower levels than the material in the dredging prism. The pesticide DDT was the only compound found in excess of the SL (6.9 ug/kg). Of 16 samples analyzed for DDT, 10 exceeded the SL with levels ranging from 7.1 to 51.3 ug/kg (Table 2). The bioaccumulation level of concern is 50 µg/kg; only one sample (CS-GC-08A in the dredging prism) exceeded this level at 51.3 µg/kg.

Biological Testing

Tier III biological testing was recommended to characterize potential biological effects from inwater disposal because of the DDT sediment concentrations greater than the SL and bioaccumulation level of concern. A list of dredging scenarios was developed from preliminary discussions of the meandering channel design to aid in determining what kind of bioassay sampling should be conducted. Table 3 provides information on proposed dredge locations and volumes, and the associated DDT concentrations in each area.

A review team, including DEQ, the Corps, the City of Portland, and MCDD recommended that five composite samples be collected, one each from Areas 1, 3, 4, 5, and 8. Each composite sample was comprised of three sediment samples collected from each area with a gravity core. The bioassays consisted of tests for 2 species (Amphipod – *Hyalella azteca* 10-day survival test and Midge – *Chironomus tentans* 10-day survival and growth test). The bioaccumulation test was conducted on one species (Oligocheate – *Limbriculus variegatus* 28-day tissue tesidue test). The testing is summarized below.

Area	Composite Bioassay Test	Composite Bioaccumulation Test	Composite DDT and Grain Size Analyses	# Samples/ composite
1[a]	1	1	1	3
2	--	--	--	None
3	1	--	1	3
4	1	--	1	3
5	1	--	1	3
6	--	--	--	None
7	--	--	--	None
8	1	1	1	3
[a] Reference site				

The results of the acute and chronic testing are summarized in Table 4. The amphipod results were inconclusive because the reference area failed to meet the acceptable survival criterion. The results of the midge bioassays indicated significant effects for survival in one sample (Area 3) and for growth in one sample (Area 8), but the results were somewhat inconclusive. Several things may have contributed to inconclusive results. Temperature and pH were slightly outside the recommended ranges. Ammonia levels, while not lethal, may have caused stress in some samples. It was noted that the reference and test sediments

had significant amount of woody debris (small wood chips); wood chips contain resin alkaloids that are known to be acutely lethal to many benthic invertebrate species. None of these factors can be determined to be conclusive for the outcome of the bioassays.

The bioaccumulation testing for Area 8 was evaluated by comparing DDT tissue residues of organisms exposed to the test sediment with tissue residues of animals exposed in parallel to the reference sediment CS-HC-01R. Results of the tissue analysis indicate that measured DDT tissue residues were nearly all below the method detection limit (1.0 µg/kg) in organisms exposed to the test sediment (Table 5). All measured concentrations in both the test and reference organisms were well below the FDA action limit of 5,000 µg/kg (given as the sum of DDE & DDT).

Since DDT is known to biomagnify in aquatic food webs, trophic transfer coefficients from the published literature were used to estimate potential risk to higher trophic organisms (i.e., fish consuming benthic infauna, piscivorous birds, and humans consuming fish). A biomagnification factor (BMF) of 30 was used to estimate the resultant tissue concentration in fish consuming *L. variegatus* with the measured DDT residues. Based on this analysis, the measured tissue residues in the test sediment exposed organisms represents little to no risk to wildlife or humans. A similar evaluation of tissue residues in reference exposed organisms (which were higher than test sediment exposed organisms) showed that the measured tissue residues do not represent a significant risk to benthic infauna. Additionally, based on the conservative screening level assessment provided above, these measured DDT residues in reference exposed organisms appear to represent little to no risk to higher trophic organisms (predatory fish and Bald Eagles). Finally a comparison of estimated fish tissue residues (derived from reference site exposed organisms) results in human health risks comparable to that for fish obtained from the market.

Next Steps

The chemical testing conducted by the Corps in May 1999 indicated that the only contaminant exceeding the DMEF screening levels was DDT. Subsequent biological testing indicated no risk for bioaccumulation but the bioassay testing was somewhat inconclusive.

The project team proposes to the DMMT that this project be allowed to proceed based on 40 CFR 230.60 (c):

> "To reach the determinations in Sec. 230.11 involving potential effects of the discharge on the characteristics of the disposal site, the narrative guidance in subparts C through F shall be used along with the general evaluation procedure in Sec. 230.60 and, if necessary, the chemical and biological testing sequence in Sec. 230.61. Where the discharge site is adjacent to the extraction site and subject to the same sources of contaminants, and materials at the two sites are substantially similar, the fact that the material to be discharged may be a carrier of contaminants is not likely to result in degradation of the disposal site. In such circumstances, when dissolved material and suspended particulates can be controlled to prevent carrying pollutants to less contaminated areas, testing will not be required." [Full text of 230.60 provided in Attachment A]

The 40 CFR 230.11 provides guidance of factual determinations for making findings of compliance or non-compliance with the restrictions on discharge [Full text of 230.11

provided in Attachment B]. The determinations of effects of each proposed discharge shall include the following:

(a) **Physical substrate determinations.** The purpose of this evaluation is determine if changes outside of the disposal site may occur as a result of erosion, slumpage, or other movement of the discharged material.

The project incorporates stabilization of the side-casted material with vegetation to prevent erosion or other movement of the dredged material.

(b) **Water circulation, fluctuation, and salinity determinations.** Requires determination of the nature and degree of effect that the proposed discharge will have individually and cumulatively on water, current patterns, circulation including downstream flows, and normal water fluctuation.

The project is designed to improve water circulation and quality.

(c) **Suspended particulate/turbidity determinations.** Requires determination of the nature and degree of effect that the proposed discharge will have, individually and cumulatively, in terms of potential changes in the kinds and concentrations of suspended particulate/turbidity in the vicinity of the disposal site.

Measures will be taken to minimize suspension of particulates, including stopping flow in the Slough during the activity and stabilization of the dredged benches after placement. Because MCDD can control flows and water levels within the project area, effective controls during construction of the project can be implemented. Long-term benefits of the project include increased solids retention by vegetation on the benches.

(d) **Contaminant determinations.** Requires determination of the degree to which the material proposed for discharge would introduce, relocate, or increase contaminants.

Proposed project will not increase contaminant, since material is being placed within the general area that it is dredged. Even if all material was disposed upland, the long-term redeposition of the same contaminants from the watershed is anticipated in the Slough.

(e) Aquatic ecosystem and organism determinations. Determine the nature and degree of effect that the proposed discharge will have, both individually and cumulatively, on the structure and function of the aquatic ecosystem and organisms.

Project designed to enhance structure and function of aquatic and wetland ecosystems.

Table 1. Historical Columbia Slough Sediment Project Data[1]									
Sampling Area	Sample ID	Parameter	VALUE	Q	LCRMA Screening Levels[2]	Value Exceeds LCRMA	UNITS	DL	PQL
1	CSUTS002100	4-Methylphenol	3300	E	670	x	ug/kg-dry	28	87
	CSUTS002100-DL	4-Methylphenol	3100		670	x	ug/kg-dry	55	170
	CSURS014300	Total DDT	12.3		6.9	X	ug/kg-dry	NA	NA
	CSURS025400	Total DDT	8.5		6.9	X	ug/kg-dry	NA	NA
	CSURS068500	Total DDT	12.2		6.9	X	ug/kg-dry	NA	NA
	CSURS068500-DL	Total DDT	9		6.9	X	ug/kg-dry	NA	NA
	CSURS110200	Total DDT	15.6		6.9	X	ug/kg-dry	NA	NA
	CSURS123500	Total DDT	13.1		6.9	X	ug/kg-dry	NA	NA
	CSUTS001500	Total DDT	13.8		6.9	X	ug/kg-dry	NA	NA
2	CSURS235500	Benzyl Alcohol	65	JM	57	x	ug/kg-dry	22	140
	CSURS175200	Total DDT	24.3		6.9	X	ug/kg-dry	NA	NA
	CSURS175200-DL	Total DDT	17.2		6.9	X	ug/kg-dry	NA	NA
	CSURS195400	Total DDT	9.4		6.9	X	ug/kg-dry	NA	NA
	CSURS212100	Total DDT	23		6.9	X	ug/kg-dry	NA	NA
	CSURS235500	Total DDT	44.1		6.9	X	ug/kg-dry	NA	NA
	CSURS265200	Total DDT	9.1		6.9	X	ug/kg-dry	NA	NA
	CSURS294500	Total DDT	17.7		6.9	X	ug/kg-dry	NA	NA
	CSURS308100	Total DDT	25.8		6.9	X	ug/kg-dry	NA	NA
	CSURS329400	Total DDT	7.4		6.9	X	ug/kg-dry	NA	NA
	CSUTS302500	Total DDT	9.8		6.9	X	ug/kg-dry	NA	NA
3	CSURS436400	4-Methylphenol	1400		670	x	ug/kg-dry	47	150
	CSURS416100	Total DDT	18.4		6.9	X	ug/kg-dry	NA	NA
	CSURS436400	Total DDT	9.2		6.9	X	ug/kg-dry	NA	NA
4	CSURS485200	2,4-Dimethylphenol	1000		29	x	ug/kg-dry	150	460
	CSURS485200	2-Methylphenol	460		63	x	ug/kg-dry	85	270
	CSURS485200	Benzyl Alcohol	1300		57	x	ug/kg-dry	44	290
	CSURS496400	4-Methylphenol	1200		670	x	ug/kg-dry	22	70
	CSURS496400	Total DDT	15.5		6.9	X	ug/kg-dry	NA	NA
	CSURS533300	Total DDT	15		6.9	X	ug/kg-dry	NA	NA
	CSURS573200	Total DDT	17.5		6.9	X	ug/kg-dry	NA	NA
	CSURS585500	Total DDT	9.2		6.9	X	ug/kg-dry	NA	NA
	CSURS604500	Total DDT	8		6.9	X	ug/kg-dry	NA	NA
	CSURS623200	Total DDT	27.9		6.9	X	ug/kg-dry	NA	NA
	CSUTS501300	Total DDT	17.9		6.9	X	ug/kg-dry	NA	NA
	CSUTS602300	Total DDT	23.1		6.9	X	ug/kg-dry	NA	NA
	CSUTS502100	4-Methylphenol	880		670	x	ug/kg-dry	16	52
	CSURS604500	4-Methylphenol	800		670	x	ug/kg-dry	27	85
5	CSSTS002500	Lead	510		450	x	mg/kg-dry		
	CSSTS002500	Zinc	722		410	x	mg/kg-dry		
6	CSSTS101500	Bis(2-Ethylhexyl)Phthalate	11000	E	8300	x	ug/kg-dry	10	32
	CSSTS101500-DL	Bis(2-Ethylhexyl)Phthalate	38000		8300	x	ug/kg-dry	310	960

Table 1. Historical Columbia Slough Sediment Project Data[1]

Sampling Area	Sample ID	Parameter	VALUE	Q	LCRMA Screening Levels[2]	Value Exceeds LCRMA	UNITS	DL	PQL
	CSSRS119300	Mercury	0.51		0.41	x	mg/kg-dry		
	CSSRS058100	Total DDT	13.7		6.9	X	ug/kg-dry	NA	NA
	CSSRS093200	Total DDT	36.2		6.9	X	ug/kg-dry	NA	NA
	CSSTS102500	Bis(2-Ethylhexyl)Phthalate	40000	E	8300	x	ug/kg-dry	170	550
	CSSTS102500-DL	Bis(2-Ethylhexyl)Phthalate	31000		8300	x	ug/kg-dry	350	1100
	CSSTS102500	Butylbenzyl Phthalate	1100	M	970	x	ug/kg-dry	96	300
	CSSTS102500	Cadmium	36		5.1	x	mg/kg-dry		
	CSSTS102500	Lead	510		450	x	mg/kg-dry		
	CSSTS102500	Zinc	1320		410	x	mg/kg-dry		
	CSSTS102501	Bis(2-Ethylhexyl)Phthalate	59000	E	8300	x	ug/kg-dry	130	400
	CSSTS102501-DL	Bis(2-Ethylhexyl)Phthalate	32000		8300	x	ug/kg-dry	1300	4000
	CSSTS102501	Cadmium	84		5.1	x	mg/kg-dry		
	CSSTS102501	Lead	520		450	x	mg/kg-dry		
	CSSTS102501	Zinc	1310		410	x	mg/kg-dry		
8	EDSTS201600	Dieldrin	0.02		0.01	x	mg/kg-dry		0.01
	CSSRS220400	4-Methylphenol	790		670	x	ug/kg-dry	26	83
	EDSTS202600	Dieldrin	0.02		0.01	x	mg/kg-dry		0.01
	CSSRS205300	Total DDT	9.9		6.9	X	ug/kg-dry	NA	NA
	CSSRS220400	Total DDT	16.6		6.9	X	ug/kg-dry	NA	NA
	CSSTS202500	Bis(2-Ethylhexyl)Phthalate	3800	E	8300		ug/kg-dry	17	54
	CSSTS202500-DL	Bis(2-Ethylhexyl)Phthalate	16000		8300	x	ug/kg-dry	140	430

[1] Data from the City of Portland: Columbia Slough Sediment Project, Screening Level Risk Assessment Report, Feb.1995. Only exceedances are shown.

[2]Source: USACE. 1998. Dredged Material Evaluation Framework, Lower Columbia River Management Area Draft.

Screening level = Concentrations at or below which there is no reason to believe that dredged material disposal would result in unacceptable adverse effects due to toxicity measured by sediment bioassays (suitable for aquatic disposal without the need for biological testing). These screening values were developed for the marine environment, freshwater values are under development.

Notes:

No qualifier definitions were given with database.

Table 2. Columbia Slough GI Study Pesticides (ug/kg) Results, Sampled May 18-19, 1999													
Sample I.D.	4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT	Aldrin	Dieldrin	Alpha-BHC	Delta-BHC	Endosulfan 1	Endrin	Endrin aldehyde	Hepta chlor	Hepta chlor epoxide
CS-GC-01A	<0.58	2.1	<2.0	2.1	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-A (DUP-01A)	1.8	3.5	<2.0	5.2	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-01B	<0.33	<0.69	<2.4	ND	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-02A	2.8	2.5	<1.8	5.3	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-02B	<0.26	<0.54	<1.9	ND	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-03A	4.3	6.5	<2.2	10.8	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-03B	1.9	2.8	<1.8	4.7	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-04A	5.5	8.9	<2.1	14.4	<0.12	<0.11	<0.12	<0.12	1.2	<0.19	12	<0.16	<0.26
CS-GC-04B	1.7	1.3	<1.7	3.0	<0.12	<0.11	<0.12	0.37	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-05A	14	17	<2.4	31.0	1.6	0.94	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	0.46
CS-GC-05B	3.9	7.4	<2.1	11.3	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-06A	6.3	8.6	<2.4	14.9	<0.12	<0.11	0.39	<0.12	0.72	<0.19	<1.4	<0.16	<0.26
CS-GC-06B	2.8	4.3	<1.7	7.1	<0.12	<0.11	<0.12	0.24	<0.51	<0.19	<1.4	0.17	<0.26
CS-GC-07A	14	29	<3.2	43.0	<0.12	<0.11	0.71	<0.12	<0.51	<0.19	5.1	<0.16	0.58
CS-GC-07B	16	22	3.9	41.9	<0.12	<0.11	<0.12	<0.12	1.1	<0.19	<1.4	<0.16	<0.26
CS-GC-08A	21	25	5.3	51.3	<0.12	1.2	0.47	<0.12	<0.51	1.2	<1.4	<0.16	1.8
CS-GC-08B	12	16	5.5	33.5	<0.12	1.0	0.55	<0.12	<0.51	0.78	2.9	<0.16	1.7
Screen level (SL)	DDD + DDE + DDT =			6.9	10	10	*	*	*	*	*	*	*
Mean	6.4	9.2	0.9	16.5	0.94	0.18	0.04	0.04	0.14	0.07	1.18	0.01	0.26
Maximum	21	25	5.5	51.3	1.6	1.2	0.71	0.37	1.2	1.2	12	0.17	1.8

Values detected for DDT were confirmed with second column.

* SL has not been established.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Table 3. Preliminary Meandering Channel Design Summary						
Area	Location	Proposed Dredging	Dredge Volume (cubic yards)	Inwater Disposal?	Dredging Prism DDT (ug/kg)	Bottom of Core DDT (ug/kg)
1	MCDD #1 to Whitaker Slough	Dredge to elevation 0ft	N/A	Yes	2.1	ND
2	Whitaker Slough to 78th Avenue	Dredge to elevation 0ft	N/A	Yes	5.3	ND
	78th to 82nd Avenue	Dredge to elevation 2ft	N/A	Yes	5.3	ND
3	82nd Avenue to 92nd Avenue	Dredge to elevation 2ft	13,000	Yes	10.8	4.7
4	92nd Avenue to I-205	Dredge to elevation 2ft	38,000	Yes	14.4	3.0
	I-205 to 122nd Avenue					
	122nd Avenue to 138th Avenue					
5	138th Avenue to Mid-dike levee	Dredge to elevation 2ft	28,300	Yes	31	11.3
	Mid-dike levee to 148th Avenue	Dredge to elevation 3ft				
	148th Avenue to 158th Avenue	Dredge to elevation 2ft				
6	158th Avenue to Four Corners	None	N/A	No	14.9	7.1
7	Four Corners to MCDD #4	None	N/A	No	43	41.9
8	Four Corners to Bridge B	None	N/A	No	51.3	33.5
	Bridge B to Bridge C	Dredge to elevation 5ft	13,000	Yes	51.3	33.5
	Bridge C through vegetated area east of 185th Avenue bridge	None		No	51.3	33.5
	East of 185th Avenue to Fairview Lake	Dredge to elevation 5ft		Yes	51.3	33.5
ND = Not detected N/A = Non-Applicable						

Table 4. Summary of Acute and Chronic Bioassays									
Area	Sample	H. azteca	C. tentans		% fines	% TOC	Initial Porewater NH3 (mg N/L)	ΣDDT (ug/kg)	Organic Carbon (ug/g)
		% Survival	% Survival	Growth (mg)					
	Control	92.5 (0.016)	78.8 (0.058)	1.48 (0.011)	2	0.02	0.06	N.A.	N.A.
1	CS-HC-01R	40.0 (0.046)	73.8 (0.057)	0.89 (0.056)	44	1.2	4.2	6.1	0.5
3	CS-HC-02SSG	80.0 (0.053)	28.8 (0.130)	1.46 (0.285)	50	1.6	5.2	2.4	0.15
4	CS-HC-03SSG	65.0 (0.057)	66.3 (0.092)	1.00 (0.081)	65	1.6	3.3	2.7	0.17
5	CS-HC-04SSG	53.8 (0.053)	70.0 (0.073)	0.78 (0.084)	91	2.3	6.7	5.5	0.235
8	CS-HC-05SSG-B	26.3 (0.046)	63.8 (0.073)	0.33 (0.055)	65	2.7	9.4	9.8	0.365

Table 5: Summary of bioaccumulation test results and analysis for the Columbia Slough sediment CS-HC-05SSG-B.

Sample I.D.	DDT Metabolite	Method Detection Limit (µg/kg)	Mean Tissue Conc. (µg/kg)	Steady State adjusted Tissue Concentration[1]	Comments
Control	4,4'-DDD	1.0	<0.70	N.A.	
	4,4'-DDE	1.0	<0.46	N.A.	
	4,4'DDT	1.0	<0.59	N.A.	
Reference CS-HC-01R	4,4'-DDD	1.0	<0.65	N.A.	
	4,4'-DDE	1.0	2.5	4.2	Lowest No Observable Effect Dose (NOED) reported in the ERED for a freshwater invertebrate (time of development in the midge, *C. tentans*) is 3,750 µg/Kg.
	4,4'DDT	1.0	0.48	0.8	Lowest No Observable Effect Dose (NOED) reported in the ERED for a freshwater invertebrate (mortality in the Dragonfly) is 14.4 µg/Kg
CS-HC-05SSG-B	4,4'-DDD	1.0	<0.77	N.A.	
	4,4'-DDE	1.0	0.1 (0.55 in one of 5 replicates)	0.29	Lowest No Observable Effect Dose (NOED) reported in the ERED for a freshwater invertebrate (time of development in the midge, *C. tentans*) is 3,750 µg/Kg.
	4,4'DDT	1.0	<0.64	N.A	

[1]Steady-state tissue concentrations were estimated based on a log K_{ow} value of 5.7 (from table 9-5 of the ITM) for DDT and DDE and using the function for the expected proportion of steady state concentration at 28-days developed by McFarland (1994) (figure 6-1 in the ITM).

[Code of Federal Regulations]
[Title 40, Volume 17, Parts 190 to 259]
[Revised as of July 1, 1999]
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[CITE: 40CFR230.60]

[Page 260-261]
TITLE 40--PROTECTION OF ENVIRONMENT AGENCY (CONTINUED)

PART 230--SECTION 404(b)(1) GUIDELINES FOR SPECIFICATION OF DISPOSAL SITES FOR DREDGED OR FILL MATERIAL--Table of Contents

Subpart G--Evaluation and Testing Sec.
230.60 General evaluation of dredged or fill material.

The purpose of these evaluation procedures and the chemical and biological testing sequence outlined in Sec. 230.61 is to provide information to reach the determinations required by Sec. 230.11. Where the results of prior evaluations, chemical and biological tests, scientific research, and experience can provide information helpful in making a determination, these should be used. Such prior results may make new testing unnecessary. The information used shall be documented. Where the same information applies to more than one determination, it may be documented once and referenced in later determinations.

(a) If the evaluation under paragraph (b) indicates the dredged or fill material is not a carrier of contaminants, then the required determinations pertaining to the presence and effects of contaminants can be made without testing. Dredged or fill material is most likely to be free from chemical, biological, or other pollutants where it is composed primarily of sand, gravel, or other naturally occurring inert material. Dredged material so composed is generally found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels. However, when such material is discolored or contains other indications that contaminants may be present, further inquiry should be made.

(b) The extraction site shall be examined in order to assess whether it is sufficiently removed from sources of pollution to provide reasonable assurance that the proposed discharge material is not a carrier of contaminants. Factors to be considered include but are not limited to:

(1) Potential routes of contaminants or contaminated sediments to the extraction site, based on hydrographic or other maps, aerial photography, or other materials that show watercourses, surface relief, proximity to tidal movement, private and public roads, location of buildings, municipal and industrial areas, and agricultural or forest lands.

(2) Pertinent results from tests previously carried out on the material at the extraction site, or carried out on similar material for other permitted projects in the vicinity. Materials shall be considered similar if the sources of contamination, the physical configuration of the sites and the sediment composition of the materials are comparable, in light of water circulation and stratification, sediment accumulation and general sediment characteristics. Tests from other sites may be relied on only if no changes have occurred at the extraction sites to render the results irrelevant.

(3) Any potential for significant introduction of persistent pesticides from land runoff or percolation;

(4) Any records of spills or disposal of petroleum products or substances designated as hazardous under section 311 of the Clean Water Act (See 40 CFR part 116);

(5) Information in Federal, State and local records indicating significant introduction of pollutants from industries, municipalities, or other sources, including types and amounts of waste materials discharged along the potential routes of contaminants to the extraction site; and

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(6) Any possibility of the presence of substantial natural deposits of minerals or other substances which could be released to the aquatic environment in harmful quantities by man-induced discharge activities.

(c) To reach the determinations in Sec. 230.11 involving potential effects of the discharge on the characteristics of the disposal site, the narrative guidance in subparts C through F shall be used along with the general evaluation procedure in Sec. 230.60 and, if necessary, the chemical and biological testing sequence in Sec. 230.61. Where the discharge site is adjacent to the extraction site and subject to the same sources of contaminants, and materials at the two sites are substantially similar, the fact that the material to be discharged may be a carrier of contaminants is not likely to result in degradation of the disposal site. In such circumstances, when dissolved material and suspended particulates can be controlled to prevent carrying pollutants to less contaminated areas, testing will not be required.

(d) Even if the Sec. 230.60(b) evaluation (previous tests, the presence of polluting industries and information about their discharge or runoff into waters of the U.S., bioinventories, etc.) leads to the conclusion that there is a high probability that the material proposed for discharge is a carrier of contaminants, testing may not be necessary if constraints are available to reduce contamination to acceptable levels within the disposal site and to prevent contaminants from being transported beyond the boundaries of the disposal site, if such constraints are acceptable to the permitting authority and the Regional Administrator, and if the potential discharger is willing and able to implement such constraints. However, even if tests are not performed, the permitting authority must still determine the probable impact of the operation on the receiving aquatic ecosystem. Any decision not to test must be explained in the determinations made under Sec. 230.11.

[Code of Federal Regulations]
[Title 40, Volume 17, Parts 190 to 259]
[Revised as of July 1, 1999]
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TITLE 40--PROTECTION OF ENVIRONMENT AGENCY (CONTINUED)

PART 230--SECTION 404(b)(1) GUIDELINES FOR SPECIFICATION OF DISPOSAL SITES FOR DREDGED OR FILL MATERIAL--Table of Contents

Subpart B--Compliance With the Guidelines

Sec. 230.11 Factual determinations.

The permitting authority shall determine in writing the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment in light of subparts C through F. Such factual determinations shall be used in Sec. 230.12 in making findings of compliance or non-compliance with the restrictions on discharge in Sec. 230.10. The evaluation and testing procedures described in Sec. 230.60 and Sec. 230.61 of subpart G shall be used as necessary to make, and shall be described in, such determination. The determinations of effects of each proposed discharge shall include the following:

(a) Physical substrate determinations. Determine the nature and degree of effect that the proposed discharge will have, individually and cumulatively, on the characteristics of the substrate at the proposed disposal site. Consideration shall be given to the similarity in particle size, shape, and degree of compaction of the material proposed for discharge and the material constituting the substrate at the disposal site, and any potential changes in substrate elevation and bottom contours, including changes outside of the disposal site which may occur as a result of erosion, slumpage, or other movement of the discharged material. The duration and physical extent of substrate changes shall also be considered. The possible loss of environmental values (Sec. 230.20) and actions to minimize impact (subpart H) shall also be considered in making these determinations. Potential changes in substrate elevation and bottom contours shall be predicted on the basis of the proposed method, volume, location, and rate of discharge, as well as on the individual and combined effects of current patterns, water circulation, wind and wave action, and other physical factors that may affect the movement of the discharged material.

(b) Water circulation, fluctuation, and salinity determinations. Determine the nature and degree of effect that the proposed discharge will have individually and cumulatively on water, current patterns, circulation including downstream flows, and normal water fluctuation. Consideration shall be given to water chemistry, salinity, clarity, color, odor, taste, dissolved gas levels, temperature, nutrients, and eutrophication plus other appropriate characteristics. Consideration shall also be given to the potential diversion or obstruction of flow, alterations of

bottom contours, or other significant changes in the hydrologic regime. Additional consideration of the possible loss of environmental values (Secs. 230.23 through 230.25) and actions to minimize impacts (subpart H), shall be used in

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making these determinations. Potential significant effects on the current patterns, water circulation, normal water fluctuation and salinity shall be evaluated on the basis of the proposed method, volume, location, and rate of discharge.

(c) Suspended particulate/turbidity determinations. Determine the nature and degree of effect that the proposed discharge will have, individually and cumulatively, in terms of potential changes in the kinds and concentrations of suspended particulate/turbidity in the vicinity of the disposal site. Consideration shall be given to the grain size of the material proposed for discharge, the shape and size of the plume of suspended particulates, the duration of the discharge and resulting plume and whether or not the potential changes will cause violations of applicable water quality standards. Consideration should also be given to the possible loss of environmental values (Sec. 230.21) and to actions for minimizing impacts (subpart H). Consideration shall include the proposed method, volume, location, and rate of discharge, as well as the individual and combined effects of current patterns, water circulation and fluctuations, wind and wave action, and other physical factors on the movement of suspended particulates.

(d) Contaminant determinations. Determine the degree to which the material proposed for discharge will introduce, relocate, or increase contaminants. This determination shall consider the material to be discharged, the aquatic environment at the proposed disposal site, and the availability of contaminants.

(e) Aquatic ecosystem and organism determinations. Determine the nature and degree of effect that the proposed discharge will have, both individually and cumulatively, on the structure and function of the aquatic ecosystem and organisms. Consideration shall be given to the effect at the proposed disposal site of potential changes in substrate characteristics and elevation, water or substrate chemistry, nutrients, currents, circulation, fluctuation, and salinity, on the recolonization and existence of indigenous aquatic organisms or communities. Possible loss of environmental values (Sec. 230.31), and actions to minimize impacts (subpart H) shall be examined. Tests as described in Sec. 230.61 (Evaluation and Testing), may be required to provide information on the effect of the discharge material on communities or populations of organisms expected to be exposed to it.

(f) Proposed disposal site determinations. (1) Each disposal site shall be specified through the application of these Guidelines. The mixing zone shall be confined to the smallest practicable zone within each specified disposal site that is consistent with the type of dispersion determined to be appropriate by the application of these Guidelines. In a few special cases under unique environmental conditions, where there is adequate justification to show that widespread dispersion by natural means will result in no significantly adverse environmental effects, the discharged material may be intended to be spread naturally in a very thin layer over a large area of the substrate rather than be contained within the disposal site.

(2) The permitting authority and the Regional Administrator shall consider the following factors in determining the acceptability of a proposed mixing zone:

(i) Depth of water at the disposal site;

(ii) Current velocity, direction, and variability at the disposal site;

(iii) Degree of turbulence;

(iv) Stratification attributable to causes such as obstructions, salinity or density profiles at the disposal site;

(v) Discharge vessel speed and direction, if appropriate;

(vi) Rate of discharge;

(vii) Ambient concentration of constituents of interest;

(viii) Dredged material characteristics, particularly concentrations of constituents, amount of material, type of material (sand, silt, clay, etc.) and settling velocities;

(ix) Number of discharge actions per unit of time;

(x) Other factors of the disposal site that affect the rates and patterns of mixing.

(g) Determination of cumulative effects on the aquatic ecosystem.

(1) Cumulative impacts are the changes in an aquatic

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ecosystem that are attributable to the collective effect of a number of individual discharges of dredged or fill material. Although the impact of a particular discharge may constitute a minor change in itself, the cumulative effect of numerous such piecemeal changes can result in a major impairment of the water resources and interfere with the productivity and water quality of existing aquatic ecosystems.

(2) Cumulative effects attributable to the discharge of dredged or fill material in waters of the United States should be predicted to the extent reasonable and practical. The permitting authority shall collect information and solicit information from other sources about the cumulative impacts on the aquatic ecosystem. This information shall be documented and considered during the decision-making process concerning the evaluation of individual permit applications, the issuance of a General permit, and monitoring and enforcement of existing permits.

(h) Determination of secondary effects on the aquatic ecosystem.

(1) Secondary effects are effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material. Information about secondary effects on aquatic ecosystems shall be considered prior to the time final section 404 action is taken by permitting authorities.

(2) Some examples of secondary effects on an aquatic ecosystem are fluctuating water levels in an impoundment and downstream associated with the operation of a dam, septic tank leaching and surface runoff from residential or commercial developments on fill, and leachate and runoff from a sanitary landfill located in waters of the U.S. Activities to be conducted on fast land created by the discharge of dredged or fill material in waters of the United States may have secondary impacts within those waters which should be considered in evaluating the impact of creating those fast lands.

Draft

Columbia Slough
Sediment Quality Evaluation
Sampled May 18-19 & Oct 6, 1999

Abstract

The Clean Water Act (CWA) of 1977, as amended regulates dredging activities and requires sediment quality evaluation, including testing, prior to dredging. Guidelines to implement 40 CFR Part 230-Section 404(b)(1) regulations of the CWA, the national Inland Testing Manual (ITM) and the regional Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF) have adopted a tiered testing approach for the evaluation of dredge material. The Tier IIa (physical testing), Tier IIb (chemical testing) and Tier III (biological testing) have been completed for this evaluation. The screening levels (SL) used are those adopted in the regional DMEF manual.

For the May 18-19, 1999 sampling event the US Army Corps of Engineers, Portland District personnel with operator and boat supplied by Multnomah County Drainage District, collected 22 gravity core samples from the Upper Channel of Columbia Slough. The approximately 10-mile long study area of the upper channel of the slough was divided into 8 sampling areas. Samples collected in each area were composited and each divided, with the top representing the dredging prism and the bottom of the core representing the "newly exposed surface" after dredging is completed. The gravity corer penetrated the sediment from 3'- 5', with retained core lengths from 2.5' to 4.5'. With few exceptions, the newly exposed surface is cleaner than the material to be dredged. The pesticide DDT (DDD+DDE+DDT) was, the only chemical of concern (COC), found in excess (7.1 to 51.3 ug/kg) of the 6.9 ug/kg SL in 10 out of 16 analyses.

Tier III biological samples were collected from the areas where DDT exceeded the SLs. Figure 2 shows areas where individual samples were collected and composited. Freshwater bioassays were analyzed for 10-day survival (*Hyalella a.*), 10-day survival and growth (*Chironomus t.)* and 28-day tissue residue (*Limbriculus v.*). The results of the biological tests did not give a clear indication which sediments were acceptable for in-water disposal. The DMEF established the Dredge Material Management Team (DMMT) to apply "best professional judgement" in making decisions on the fate of sediments where testing does not provide clear-cut answers. The DMMT will be consulted to make the final determination for the fate of the sediment in question. (See Attachment C for the Multnomah County Drainage District's (MCDD) proposal to the DMMT). (See the main Columbia Slough Report for final determination of DMMT).

Introduction

The purpose of this report is to characterize the sediment of portions of the Columbia Slough Upper Channel for the purpose of meandering channel creation based on the sampling event described. Objectives from the sampling and analysis plan are listed below. This report will outline the procedures used to accomplish these goals.

Draft

SAMPLING AND ANALYSIS OBJECTIVES

The sediment characterization program objectives and constraints are summarized below:

To characterize sediments in accordance with the regional dredge material testing manual, the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (Nov. 1998) (DMEF).

Collect, handle and analyze representative sediment, of the purposed dredging prism, in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements. Characterize sediments to be dredged for evaluation of environmental impact.

Conducted physical, chemical and biological (if needed) characterization of sediment to be dredged.

Historical Data

Numerous surface samples have been taken in the Upper Channel of the slough on various dates and locations. Most of the analyses were below the SLs of the DMEF. Those analyses exceeding the SLs were 4 heavy metals (Cd, Pb, Zn, and Hg), 3 phenol groups, 2 phthalate groups, 1 alcohol and 1 pesticide.

Table 1, Contaminates Found on Previous Sampling Events - (exceeding SL)

Area	Cd	Pb	Zn	Hg	Total DDT	4-methyl phenol	2,4-Dimethyl phenol	2-Methyl phenol	Bis (2ethylhexy) phthalate	Butyl benzyl phthalate	Benzyl Alcohol	Dieldrin
	Mg/kg (ppm)				Ug/kg (ppb)							
1					12.3 8.5 12.2 9 15.6 13.1 13.8			3300 3100				
2					24.3 17.2 9.4 23 44.1 9.1 17.7 25.8 7.4 7.1 9.8						65	
3					18.4 9.2	1400						
4					19 15.5 15	1200 880 800	1000	460			1300	

					17.5 9.2 8 27.9 17.9 23.1							
5		510	722									
6	36 84	510 520	132 0 131 0	.51	13.7 36.2 9.3				11000 38000 40000 31000 59000 32000	1100		
7					9.3							
8					9.9 16.6	790			16000			20 20
SL	5.1	450	410	0.41	6.9	670	29	670	8300	970	57	10

Current Sampling Event

The US Army Corps of Engineers, Portland District personnel with operator and boat supplied by Multnomah County Drainage District, collected gravity core samples from the Upper Channel of Columbia Slough on May 18-19, 1999. The Upper Channel study area was divided into 8 sampling areas (see figure 1). The approximately 10-mile long study area of the upper channel of the slough was divided into 8 sampling areas. Samples collected in each area were composited and each divided, with the top representing the dredging prism and the bottom of the core representing the "newly exposed surface" after dredging is completed. The gravity corer penetrated the sediment from 3'- 5', with retained core lengths from 2.5' to 4.5'. With few exceptions, the newly exposed surface is cleaner than the material to be dredged. The pesticide DDT (DDD+DDE+DDT) was, the only COC, found in excess (7.1 to 51.3 ug/kg) of the 6.9 ug/kg SL in 10 out of 16 analyses. The eight composite core samples were divided, with the top representing the dredging prism and the bottom 6" to 12", representing the "newly exposed surface" after dredging is completed.

On October 6, 1999 one (1) composite reference and 4 composite samples were submitted for Tier III biological analysis from the areas where DDT exceeded the SLs. Figure 2 shows areas where individual samples were collected and composited. These samples were analyzed for 10-day survival (*Hyalella a.*), 10-day survival and growth (*Chironomus t.)* and 28-day tissue residue (*Limbriculus v.*).

Results/Discussion

Physical and Volatile Solids: Data for the May 18-19, 1999 physical analyses are presented in Table 2. All samples submitted for analysis exceeded 20% fines with 7 of 16 exceeding 5% volatile solids. Four (4) samples submitted were classified as "silty sand", with 12 samples classified as "silt". Median grain size for all samples is 0.05 mm, with 38.2 % sand and 61.1% fines. All samples were dark brown to dark gray in color with very little odor and no sheen. Nine (9) samples contained wood chips.

Data for the October 6, 1999 physical analyses are presented in Table 3. All samples submitted for analysis exceeded 20% fines with 2 of 5 exceeding 5% volatile solids. All 5 samples collected were classified as "silt". Median grain size for all samples is 0.05 mm, with 37.6 % sand and 62.4% fines. All samples were dark brown to dark gray in color with very little odor and no sheen. All samples contained wood chips.

Metals and Total Organic Carbon (TOC): Data for the May 18-19, 1999 analyses are presented in Table 4. Low levels of some metals were found in most of the samples collected, but levels do not approach the SL. The highest level detected was for mercury, which is 75.7% of the SL. Cadmium was the next highest level detected in a metal, at 45.1% of the SL. Total Organic Carbon values ranged from 5800 to 33000 mg/kg.

Pesticide/PCBs, Phenols, Phthalates and Misc. Extractables: Data for the May 18-19, 1999 analyses are presented in Table 5 & 7. No PCBs were found at the method detection limits. Total DDT was found in all but 2 samples, with 10 of 16 exceeding the 6.9 ug/kg SL. Only 1 sample (CS-GC-08A) exceeded the bioaccumulation trigger of 50 ug/kg. Three phenols were detected at low levels (highest 27.5% of SL). Five (5) phthalates were detected at low levels (highest 13.4% of SL). Benzoic Acid and Benzyl Alcohol were found in 2 of the 16 samples at low levels (highest 1.3% of SL). Dibenzofuran was detected in 11 of 16 samples (highest 56.9% of SL).

Data for the October 6, 1999 DDT Sediment analyses are presented in Table 6. DDT or its breakdown components were detected in all samples, with only sample CS-HC-05SSG-B (from area 8) exceeding the screening level, at 8.9 ug/kg.

Data for the October 6, 1999 DDT Tissue analyses are presented in Table 6. No DDT was detected in the Control sample at the method detection limit. DDT was detected in the reference sample in all five replicates, ranging from 0.9 to 4.4 ug/kg. The only sample submitted for bioaccumulation analysis was CS-HC-05SSG-B. One (1) of 5 replicates indicated bioaccumulation above the method detection limit at 0.55 ug/kg.

Polynuclear Aromatic Hydrocarbons (PAHs): Data for the May 18-19, 1999 sample analyses are presented in Tables 8 & 9 (PAHs were not run on the Oct. 6, 1999 sediment samples). Low levels of some individual "low molecular weight" PAHs were found in all samples, highest is 24% of SL. Most of the "high molecular weight" PAHs were found in all samples, highest is 68.7% of SL.

Bioassay/Bioaccumulation: Data for the October 6, 1999 samples analyses are presented in Attachment A and B (MEC laboratory reports and evaluations).

The results of the Bioassay samples indicated no bioaccumulation for DDT in the sample tested (CS-HC-05SSG-B, Area 8) (See Attachment B). The lowest acceptable survival for *Hyalella* in reference sediment is 70%. The survival in the test reference was 40%; this constitutes a failure in the reference. A 15% mortality rate less than the reference is allowable for the test sediment. If the reference were at the minimum acceptable level of 70%, the lowest test sediment level would be 59.5%. At this lowest allowable reference level, samples CS-HC-04SSG and CS-HC-

05SSG-B would fail the 15% less than reference requirement, at 53.8 and 26.3 respectively. The Chironomus test results indicate sample CS-HC-02SSG failed the survival at 28.8% and was statistically different. Sample CS-HC-05SSG-B failed the growth test with a mean reduction in biomass greater than 40% and has statistically significant difference.

Conclusion

Collection and evaluation of the sediment data was completed using guidelines from both the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF) and the Inland Testing Manual (ITM). The DMEF is a regional manual developed jointly with regional EPA, Corps, Oregon Dept. of Environmental Quality and Washington Depts. of Ecology and Natural Resources. The ITM is a national manual developed jointly by EPA and Corps for dredge material evaluation. These documents are guidelines for implementing the Clean Water Act, 40 CFR 230 sec 404 (b)(1).

The screening levels used are those adopted for use in the DMEF. The DMEF Tiered testing approach requires that material in excess of 20% fines and greater than 5% volatile solids, as well as any material with prior history or is suspected ("reason to believe") of being contaminated, be subjected to chemical as well as physical analyses. Under the Tiered approach, if the chemical analytical results do not exceed the established screening levels (SL), the material is suitable for unconfined in-water disposal. If the material represented by the Tier IIb chemical samples exceeds the established SLs, the material must be subjected to Tier III, bioassay analyses.

The DMEF states that in a freshwater bioassay the control and reference have performance standards that must be met, depending on the bioassay test performed and all results must be statistically significant.

For the amphipod (*Hyalella a.*) bioassay a performance standard of 20% absolute mean mortality is set for the control sample. The reference must have a performance standard of 30% absolute mean mortality. The test sediment must have a mean test mortality no more than 15% below reference response.

The midge (*Chironomus t.*) bioassay control must have a performance standard of 30% absolute mean mortality and a growth performance standard of 0.6 mg minimum mean weight per organism. The reference must have a performance standard of 35% absolute mean mortality. The test sediment must have a mean test mortality no more than 20% below reference response, for the growth test the mean reduction in biomass can be no greater than 40%.

The Tier IIb, chemical, analyses indicated exceedances of DMEF screening levels for total DDT (see table 5) in 10 of 16 analysis, with the bioaccumulation trigger of 50 ug/kg exceeded in 1 sample (CS-GC-08A, Area 8). Bioassay samples were collected from the areas that exceeded SLs on October 6, 1999. The results of the Bioassay samples indicated no bioaccumulation for DDT in the sample tested (CS-HC-05SSG-B, Area 8) (See Attachment B). The lowest acceptable survival for *Hyalella* in reference sediment is 70%. The survival in the test reference

was 40%; this constitutes a failure in the reference. A 15% mortality rate less than the reference is allowable for the test sediment. If the reference were at the minimum acceptable level of 70%, the lowest test sediment level would be 55%. At this lowest allowable reference level, samples CS-HC-04SSG and CS-HC-05SSG-B would fail the 15% less than reference requirement, at 53.8 and 26.3 respectively. The Chironomus test results indicate sample CS-HC-02SSG failed the survival at 28.8% and was statistically different. Sample CS-HC-05SSG-B failed the growth test with a mean reduction in biomass greater than 40% and has statistically significant difference.

These results were presented to the Dredge Material Management Team (DMMT) on February 16, 2000 (See Attachment C for presentation). The DMMT's interpretation of the results will be forthcoming. The DMMT's initial interpretation, at the presentation, indicated areas where sediment failed bioaccumulation would require upland disposal, without return water to the slough. The DDT levels in sediment to be place upland would not pose human health concerns.

References

U.S. army Corps of Engineers, Portland District, Seattle District; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington State Department of Natural Resources and Department of Ecology. 1998 Final. Dredge Material Evaluation Framework for the Lower Columbia River Management Area.

U. S. Environmental Protection Agency and U. S. Army Corps of Engineers. February 1998. Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters – Testing Manual, dated (referred to as the "Inland Testing Manual").

The Clean Water Act, 40 CFR 230 (b) (1).

Physical Analysis

	Grain Size (mm)				%					
Sample I.D.	Median		Mean		Gravel	Sand	Silt/Clay	Volatile solids		
CS-GC-01A	0.07		0.07		0.10	59.3	40.5		4.61	
CS-GC-01B	0.05		0.03		0.00	28.3	71.6		5.05	
CS-GC-02A	0.06		0.07		0.24	45.1	54.7		3.78	
CS-GC-02B	0.05		0.04		0.05	33.97	65.99		4.17	
CS-GC-03A	0.07		0.06		0.00	56.3	43.7		4.33	
CS-GC-03B	0.06		0.04		0.00	47.66	52.34		2.79	
CS-GC-04A	0.06		0.06		0.01	50.76	49.23		4.70	
CS-GC-04B	0.05		0.08		0.50	76.60	23.10		5.60	
CS-GC-05A	0.04		0.08		0.00	35.66	64.34		5.96	
CS-GC-05B	0.04		0.04		0.00	23.33	76.67		4.91	
CS-GC-06A	0.04		0.09		0.00	28.87	71.12		5.20	
CS-GC-06B	0.08		0.03		0.41	32.77	66.82		3.26	
CS-GC-07A	0.03		0.06		0.00	17.27	82.73		7.73	
CS-GC-07B	0.03		0.01		0.00	8.05	91.95		7.93	
CS-GC-08A	0.06		0.07		0.00	34.65	65.35		9.80	
CS-GC-08B	0.05		0.81		7.74	32.15	60.12		5.96	
CS-GC-08B (lab dup.)	0.05		0.66		9.36	32.49	56.15		6.18	
Mean	0.05		0.09		0.62	38.18	61.14		5.37	
Minimum	0.03		0.01		0.00	8.05	23.10		2.79	
Maximum	0.08		0.81		9.36	76.60	82.73		9.80	

Table 3, Columbia Slough GI Study

Sampled Oct 6, 1999

Physical Analysis

	Grain Size (mm)				%					
Sample I.D.	Median		Mean		Gravel	Sand	Silt/Clay	Volatile solids		
CS-HC-01R (reference sample)	0.08		0.05		0.0	61.4	38.6		4.35	
CS-GC-02SSG	0.06		0.06		0.0	46.8	53.2		4.92	
CS-GC-03SSG	0.05		0.05		0.0	38.1	61.9		4.76	
CS-GC-04SSG	0.02		0.04		0.0	13.8	86.2		7.00	
CS-GC-05SSG-B	0.04		0.05		0.0	29.4	70.6		6.53	
CS-GC-05SSG-B (lab duplicate)	0.02		0.05		0.0	26.2	73.8		7.07	
Mean	0.05		0.05		0.0	37.6	62.4		5.57	
Minimum	0.02		0.04		0.0	13.8	38.6		4.35	
Maximum	0.08		0.06		0.0	61.4	86.2		7.07	

Table 4, Columbia Slough GI Study

Sampled May 18-19, 1999

Inorganic Metals and Total Organic Carbon

Sample I.D.	As	Sb	Cd	Cu	Pb	Hg	Ni	Ag	Zn	TOC
	mg/kg (ppm)									
CS-GC-01A	3.3	<70	1	33	<11	<.11	13	0.61	110	13000
CS-A (DUP -01A)	3.7	<70	0.74	23	<11	<.11	18	0.29	120	14000
CS-GC-01B	6	<70	0.75	38	<11	<.11	17	0.67	110	13000
CS-GC-02A	3.3	<70	0.49	29	<11	<.11	17	0.39	73	8400
CS-GC-02B	2.1	<70	0.29	29	<11	<.11	17	0.34	59	8600
CS-GC-03A	2.8	<70	0.79	31	<11	<.11	16	0.44	99	15000
CS-GC-03B	2.2	<70	0.47	24	<11	<.11	13	0.27	72	5800
CS-GC-04A	3.1	<70	0.77	30	<11	<.11	23	0.39	130	16000
CS-GC-04B	2	<70	0.4	22	<11	<.11	11	0.27	61	11000
CS-GC-05A	3.8	<70	1.1	53	42	0.31	26	0.41	130	21000
CS-GC-05B	2.8	<70	0.6	45	<11	<.11	18	0.39	79	16000
CS-GC-06A	3.8	<70	0.71	29	<11	<.11	17	0.5	110	15000
CS-GC-06B	2.6	<70	0.33	29	<11	<.11	13	0.35	70	7400
CS-GC-07A	4.3	<70	1.1	43	55	0.16	23	0.54	160	27000
CS-GC-07B	4.9	<70	2.3	38	24	0.21	17	0.59	130	22000
CS-GC-08A	3.1	<70	1.3	38	37	<.11	19	0.53	170	33000
CS-GC-08B	3.6	<70	0.82	33	51	<.11	23	0.49	140	21000
Screening level (SL)	57	150	5.1	390	450	0.41	140	6.1	410	
Mean	3.4	ND	0.82	33.35	12.29	0.04	17.7	0.44	107.2	
Maximum	6.0	ND	2.3	53	55	0.31	26	0.67	170	

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Pesticides/PCBs

Sample I.D.	Pesticides												
	ug/kg (ppb)												
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT	Aldrin	Dieldrin	Alpha-BHC	Delta-BHC	Endosulfan 1	Endrin	Endrin aldehyde	Hepta chlor	Hepta chlor epoxide
CS-GC-01A	<0.58	2.1	<2.0	2.1	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-A (DUP-01A)	1.8	3.5	<2.0	5.2	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-01B	<0.33	<0.69	<2.4	ND	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-02A	2.8	2.5	<1.8	5.3	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-02B	<0.26	<0.54	<1.9	ND	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-03A	**4.3**	**6.5**	<2.2	**10.8**	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-03B	1.9	2.8	<1.8	4.7	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-04A	**5.5**	**8.9**	<2.1	**14.4**	<0.12	<0.11	<0.12	<0.12	*1.2*	<0.19	*12*	<0.16	<0.26
CS-GC-04B	1.7	1.3	<1.7	3.0	<0.12	<0.11	<0.12	*0.37*	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-05A	**14**	**17**	<2.4	**31.0**	*1.6*	*0.94*	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	*0.46*
CS-GC-05B	**3.9**	**7.4**	<2.1	**11.3**	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-06A	**6.3**	**8.6**	<2.4	**14.9**	<0.12	<0.11	*0.39*	<0.12	*0.72*	<0.19	<1.4	<0.16	<0.26
CS-GC-06B	**2.8**	**4.3**	<1.7	**7.1**	<0.12	<0.11	<0.12	*0.24*	<0.51	<0.19	<1.4	*0.17*	<0.26
CS-GC-07A	**14**	**29**	<3.2	**43.0**	<0.12	<0.11	*0.71*	<0.12	<0.51	<0.19	*5.1*	<0.16	*0.58*
CS-GC-07B	**16**	**22**	**3.9**	**41.9**	<0.12	<0.11	<0.12	<0.12	*1.1*	<0.19	<1.4	<0.16	<0.26
CS-GC-08A	**21**	**25**	**5.3**	**51.3**	<0.12	*1.2*	*0.47*	<0.12	<0.51	*1.2*	<1.4	<0.16	*1.8*
CS-GC-08B	**12**	**16**	**5.5**	**33.5**	<0.12	*1.0*	*0.55*	<0.12	<0.51	*0.78*	*2.9*	<0.16	*1.7*
Screen level (SL)	DDD + DDE + DDT =			6.9	10	10	*	*	*	*	*	*	*
Mean	6.4	9.2	0.9	16.5	0.94	0.18	0.04	0.04	0.14	0.07	1.18	0.01	0.26
Maximum	21	25	5.5	51.3	1.6	1.2	0.71	0.37	1.2	1.2	12	0.17	1.8

Values detected for DDT were confirmed with second column.

PCBs = Non-detect (ND) <19.0 ppb (SL = 130 ppb).

* SL has not been established.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Tier III
DDT Sediment Analysis

Sample I.D.	ug/kg (ppb)			
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT
CS-HC-01R	1.5	2.5	2.1	6.1
CS-HC-02SSG	<0.6	2.4	<2.1	2.4
CS-HC-03SSG	<0.28	2.7	<2.1	2.7
CS-HC-04SSG	2.1	3.4	<2.8	5.5
CS-HC-05SSG-B	**4.3**	**5.5**	<2.1	**8.9**
Screening Level	DDD +	DDE +	DDT +	= 6.9

* Aroclor 1260 was detected at 23 ug/kg (SL = 130) & Endrin was detected at 3.5 ug/kg (no SL) in sample CS-HC-05SSG-B.

Tier III
DDT Tissue Analysis

Sample I.D.					Sample I.D.					Sample I.D.				
	ug/kg (ppb)													
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT		4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT		4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT
Control					CS-HC-01R Reference					CS-HC-05 SSG-B				
Rep - 1	<0.77	<0.51	<0.65	ND	Rep - 1	<0.59	4.4	<0.50	4.4	Rep - 1	<0.98	<0.65	<0.82	ND
Rep - 2	<0.83	<0.55	<0.69	ND	Rep - 2	<0.82	1.0	1.0	2.0	Rep - 2	<0.69	<0.49	<0.58	ND
Rep - 3	<0.71	<0.47	<0.59	ND	Rep - 3	<0.59	0.9	<0.49	0.9	Rep - 3	<0.59	0.55	<0.49	0.55
Rep - 4	<0.61	<0.40	<0.51	ND	Rep - 4	<0.69	3.7	<0.58	3.7	Rep - 4	<0.79	<0.53	<0.66	ND
Rep - 5	<0.59	<0.39	<0.49	ND	Rep – 5	<0.58	2.5	1.4	3.9	Rep - 5	<0.79	<0.52	<0.66	ND
Mean				ND			2.5	0.48	2.98			0.11		0.11

Values detected for DDT were confirmed with second column.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Phenols, Phthalates and Extractables

Sample I.D.	Phenols			Phthalates					Extractables		
	ug/kg (ppb)										
	Penta chloro phenol	3-&4-Methyl phenol	Phenol	bis(2-Ethylhexzyl phthalate	Dimethyl phthalate	Di-n-butyl phthalate	Diethyl phthalate	Butylbenzyl phthalate	Dibenzo furan	Benzoic Acid	Benzyl Alcohol
CS-GC-01A	110	4.8	<9.7	130	4	21	33	<11	<2.9	23	<4.3
CS-A (DUP-01A)	<1.9	3.3	<9.7	59	11	11	14	28	<2.9	26	<4.3
CS-GC-01B	90	8.9	23	6.9	<13	7.9	7.9	<11	<2.9	<7.1	<4.3
CS-GC-02A	41	<1.6	<9.7	23	<13	9.2	22	<11	<2.9	<7.1	<4.3
CS-GC-02B	48	<1.6	14	18	<13	14	34	<11	<2.9	13	<4.3
CS-GC-03A	75	25	17	210	2.7	11	<4.7	14	<2.9	210	4.3
CS-GC-03B	44	3.5	7.8	28	<13	4.7	<4.7	<11	<2.9	370	<4.3
CS-GC-04A	61	3.9	<9.7	310	3.4	40	24	130	<2.9	19	<4.3
CS-GC-04B	34	3.7	10	11	<13	10	14	<11	<2.9	120	4.6
CS-GC-05A	<1.9	<1.6	<9.7	710	14	460	80	<11	7.2	<7.1	<4.3
CS-GC-05B	<1.9	<1.6	<9.7	210	<13	29	11	<11	<2.9	<7.1	<4.3
CS-GC-06A	<1.9	7.7	<9.7	190	3.2	39	29	15	<2.9	16	<4.3
CS-GC-06B	<1.9	<1.6	<9.7	29	<13	29	9	<11	<2.9	12	<4.3
CS-GC-07A	74	<1.6	<9.7	230	3.7	12	<4.7	<11	4.7	16	<4.3
CS-GC-07B	<1.9	<1.6	<9.7	200	<13	<3.5	<4.7	<11	<2.9	8.7	<4.3
CS-GC-08A	<1.9	7.2	<9.7	480	7.5	110	56	<11	<2.9	56	<4.3
CS-GC-08B	<1.9	<1.6	<9.7	230	4.4	25	11	<11	<2.9	<7.1	<4.3
Screen level (SL)	400	670	420	8300	1400	5100	1200	970	540	650	540
Mean	33.9	4	4.2	180.9	3.2	49	20.3	11	0.7	52.3	0.52
Maximum	110	25	23	710	14	460	80	130	7.2	370	4.6

Values detected for DDT were confirmed with second column.

PCBs = Non-detect (ND) <18.0 ppb (SL = 130 ppb).

Chlorinated Herbicides (Method 8151) = Non-detect (ND) <19.0 ppb, (SL has not been set).

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Polynuclear Aromatic Hydrocarbons (PAHs)

Low Molecular Weight Analytes

ug/kg (ppb)

Sample I.D.	Acenapththene	Acenaphthylene	Anthracene	Fluorene	2-Methyl napthalene	Naphthalene	Phenanthrene	Total Low PAHs
CS-GC-01A	3.3	9.4	7.5	4.4	3.1	7.7	35	70.4
CS-A(DUP-01A)	<1.9	10	7.5	<2.4	<2.3	3.5	32	53
CS-GC-01B	<1.9	13	4.6	<2.4	<2.3	<2.0	19	36.6
CS-GC-02A	11	<2.3	4.5	<2.4	<2.3	<2.0	16	31.5
CS-GC-02B	<1.9	<2.3	<2.3	<2.4	<2.3	<2.0	3.4	3.4
CS-GC-03A	<1.9	9.6	5.9	<2.4	<2.3	3.4	26	44.9
CS-GC-03B	<1.9	<2.4	<2.3	<2.4	<2.3	<2.0	6.5	6.5
CS-GC-04A	<1.9	<2.4	3	<2.4	<2.3	<2.0	9.6	12.6
CS-GC-04B	<1.9	<2.4	<2.3	<2.4	<2.3	<2.0	2.3	2.3
CS-GC-05A	9.3	<2.4	22	23	<2.3	<2.0	61	115.3
CS-GC-05B	<1.9	5	4.1	4.3	<2.3	<2.0	13	26.4
CS-GC-06A	14	130	82	14	<2.3	5.6	360	605.6
CS-GC-06B	<1.9	4.3	<2.3	<2.4	<2.3	<2.0	8	12.3
CS-GC-07A	6.1	11	14	9.4	3.7	18	59	121.2
CS-GC-07B	<1.9	3.6	<2.3	3.6	<2.3	<2.0	13	20.2
CS-GC-08A	5.7	8.8	15	9.1	5.3	7.9	47	98.8
CS-GC-08B	3.6	4.1	9.3	4.4	<2.3	3.3	55	79.7
Screen level (SL)	500	560	960	540	670	2100	1500	29000
Mean	3.1	12.3	0.24	4.2	0.7	2.9	45	
Maximum	11	130	82	23	5.3	18	360	

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Polynuclear Aromatic Hydrocarbons (PAHs)

High Molecular Weight Analytes

ug/kg (ppb)

Sample I.D.	Benzo(a)anthracene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Pyrene	Benzo(a)pyrene	Dibenz(a,h)anthracene	Indeno(1,2,3-cd)pyrene	Fluoranthene	Total High PAHs
CS-GC-01A	30	8.8	38	46	59	110	45	<2.2	40	81	457.8
CS-A(DUP-01A)	17	260	88	<2.1	24	63	<2.1	<2.1	<2.1	58	510
CS-GC-01B	9.9	<2.5	11	25	20	48	18	<2.5	15	42	188.9
CS-GC-02A	16	18	9.9	25	19	45	7.3	<1.9	14	46	200.2
CS-GC-02B	<2.1	<2.1	<2.1	<2.1	<2.1	5.2	<2.1	<2.1	2.5	5	12.7
CS-GC-03A	20	37	15	32	34	72	24	<2.3	22	64	320
CS-GC-03B	5.2	14	6.6	9.7	11	15	<1.9	<1.9	8	18	87.5
CS-GC-04A	11	21	6.6	16	19	29	11	<2.3	10	27	150.6
CS-GC-04B	4.1	<1.9	<1.9	4.3	<1.9	19	<1.9	<1.9	<1.9	23	50.4
CS-GC-05A	56	70	31	62	91	130	93	<2.6	45	150	728
CS-GC-05B	14	<2.0	<2.0	<2.0	10	29	24	<2.6	<2.0	28	105
CS-GC-06A	370	440	120	460	490	1300	540	<2.6	300	1100	5120
CS-GC-06B	3.5	10	2.9	9.2	5.1	13	10	<2.0	6.4	18	78.1
CS-GC-07A	28	31	12	42	35	57	36	<3.4	30	99	370
CS-GC-07B	6.6	<3.0	<3.0	14	11	31	<3.0	<3.0	<3.0	27	89.6
CS-GC-08A	47	<3.1	<3.1	48	84	110	57	<3.1	27	120	493
CS-GC-08B	35	47	16	28	58	97	<2.6	<2.6	<2.6	120	401
Screen level (SL)	1300	3200		670	1400	2600	1600	230	600	1700	12000
Mean	39.6	77.3		48.3	57.1	127.8	50.9	ND	30.5	119.2	
Maximum	370	560		460	490	1300	540	ND	300	1100	

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Figure 1, Columbia Slough Tier II Sampling Event –May 18-19, 1999

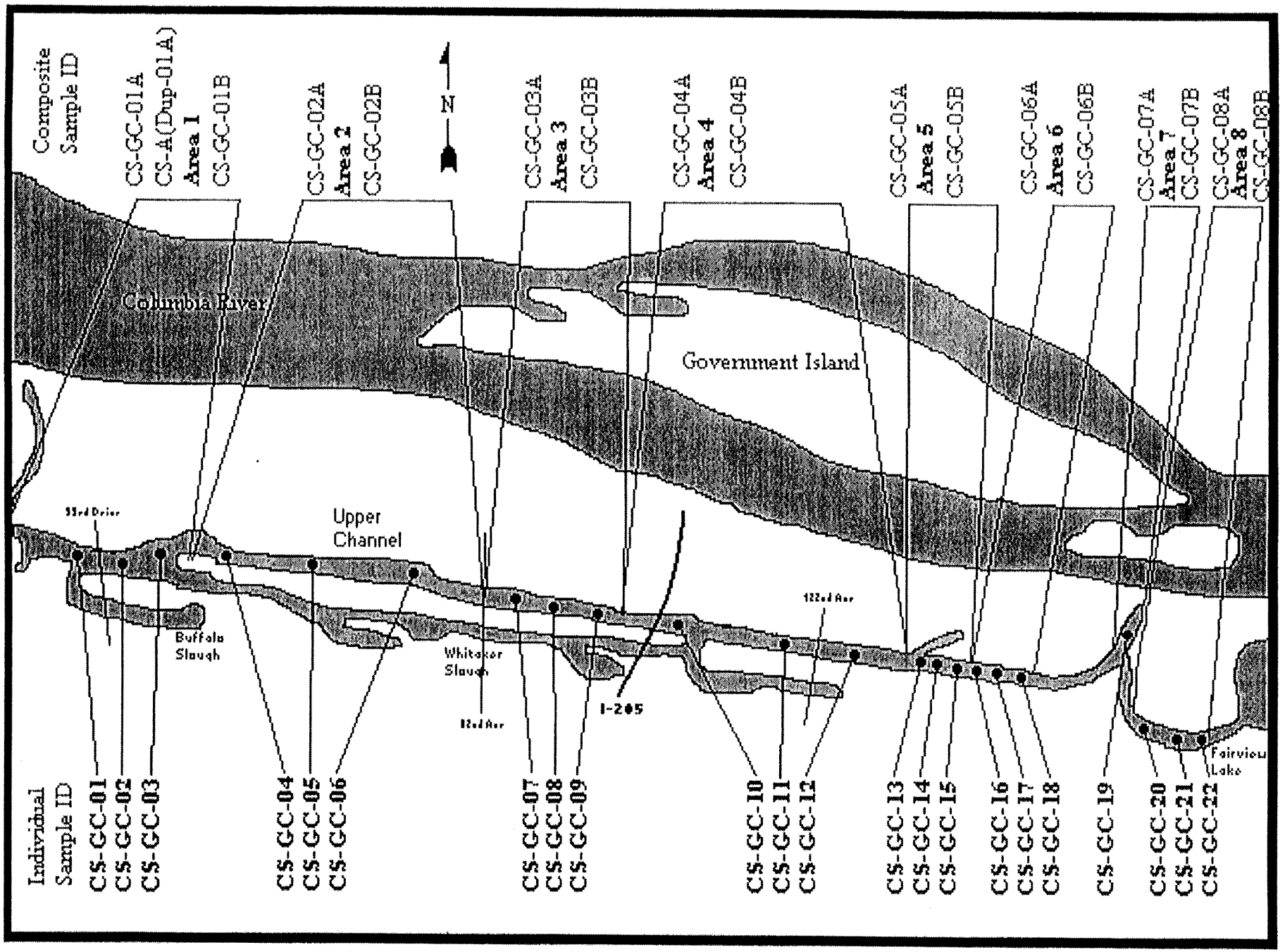
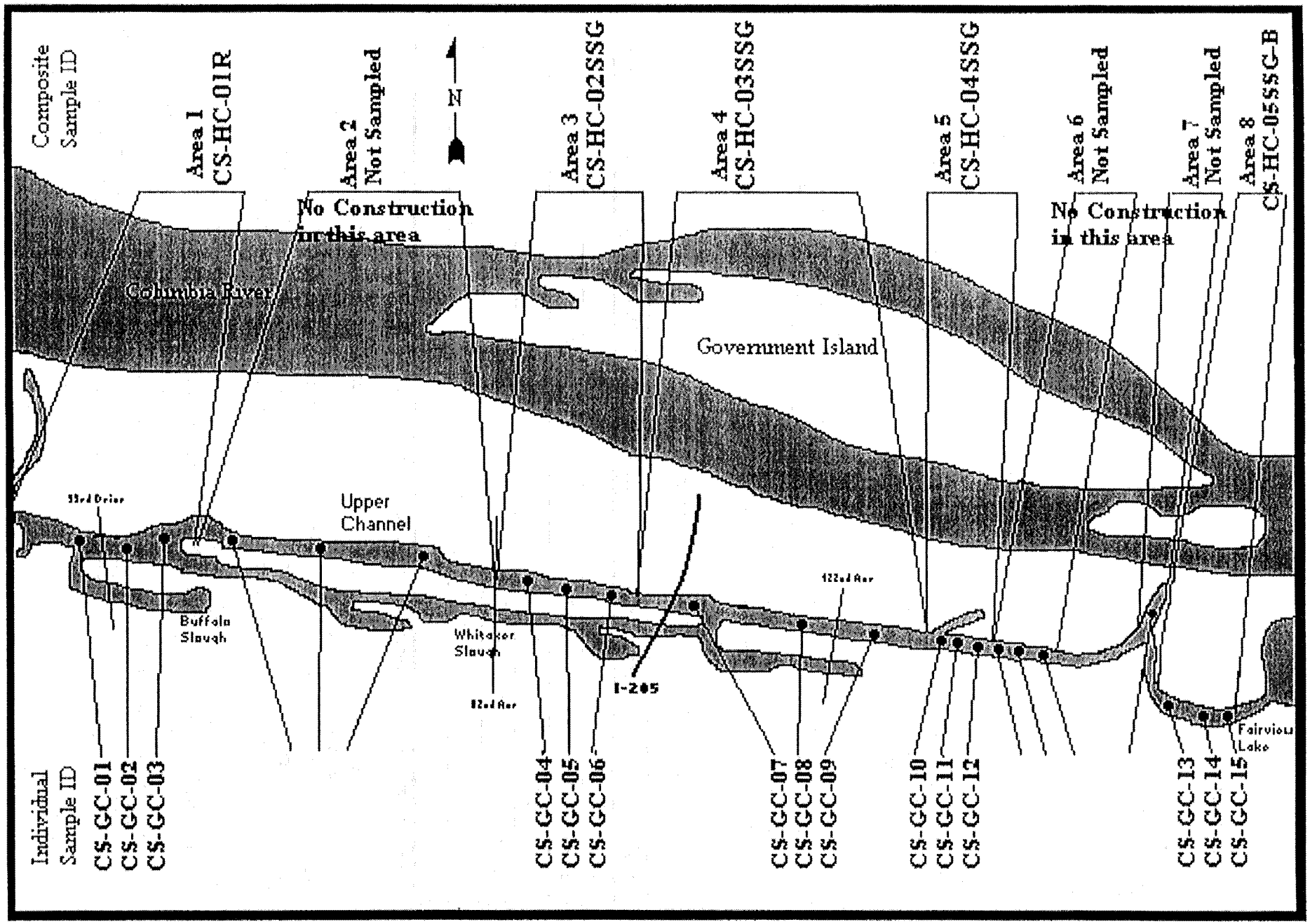


Figure 2, Columbia Slough Tier III Sampling Event –Oct 6, 1999



Attachment A
MEC Bioassay Evaluation

19 December 1999

USACE (Attn. Tim Sherman)
333 SW First Avenue
Portland, OR 97204

Dear Mr. Sherman:

This document is the final letter report for the dredged material disposal sediment toxicity testing (*Chironomus tentans*, *Hyalella azteca*, and *Limbriculus variegatus*) for Columbia Slough project sediments. Included in this letter report are copies of the Chain-of-Custody (COC) forms (Attach. 1), test organism receipt information (Attach. 2), laboratory bench sheets (Attach. 3), reference toxicant bench sheets (Attach. 4), sediment porewater ammonia and overlying ammonia data (Attach. 5), statistical analysis information (Attach. 6), temperature plots (Attach. 7), and TOC and grain size data (Attach. 8). Please see tables and text below for a summary of test results.

MEC laboratory personnel received five samples (CS-HC-02SSG, CS-HC-03SSG, CS-HC04SSG, CS-HC-05SSG-B, and CS-HC-01R (reference sediment)) for sediment toxicity tests reported herein. All samples were received 08 October 1999, and were evaluated in 10-day sediment toxicity tests with the freshwater amphipod, *H. azteca* and the midge, *C. tentans*. Samples CS-HC-01R and CS-HC-O5SSG-B were evaluated in a 28-day bioaccumulation test with the freshwater Oligocheate, *Lumbriculus variegatus*.

Table 1: Sample Identification and Collection Summary

Sample Description	Client Sample I.D.	MEC Sample I.D.	Date Collected	Date Received	COC #
Reference Sediment	CS-HC-01R	C991008.03	10/06/99	10/08/99	4009
Test Sediment	CS-HC-02SSG	C991008.04	10/06/99	10/08/99	4009
Test Sediment	CS-HC-03SSG	C991008.05	10/06/99	10/08/99	4009
Test Sediment	CS-HC-04SSG	C991008.06	10/06/99	10/08/99	4009
Test Sediment	CS-HC-05SSG-B	C991008.07	10/06/99	10/08/99	4009
Control Sediment	N.A. [1]	Control	N.A. [1]	N.A. [1]	N.A. [1]

[1] Not applicable (laboratory control sediment is clean sand obtained from a commercial supplier).

All samples were logged-in upon receipt. Upon receipt, the condition of each sample was noted and the temperature recorded on the COC form. All samples arrived in good conditions, however temperatures were slightly above the recommended shipping/storage temperature range of >0°C and <4°C (9.5 to 13.0°C). This deviation is not considered significant and is not expected to impact testing results. After being logged-in, samples were placed in a locked cold storage walk-in and held at 4°C until test initiation.

Sample handling, testing, and analysis was conducted in accordance with the Inland Testing Manual (ITM) (USEPA/USACE 1998) and the Dredged Material Evaluation Framework – Lower Columbia River Management Area (1998). Tests conducted by MEC included standard 10-day solid phase sediments toxicity tests with the freshwater amphipod, *Hyalella azteca* (USEPA 1994; as revised 1998, MEC SOP# BIO068.00) and the midge, *Chironomus tentans* (USEPA 1994; as revised 1998, MEC SOP# BIO069.00); and a 28-day bioaccumulation test with the freshwater oligochaete, *Lumbriculus variegatus*

Attachment A
MEC Bioassay Evaluation

(USEPA 1994, as revised 1998, MEC SOP# BIO057.00). Initial interstitial ammonia was measured on Day 0 for 10-day solid phase testing. Ammonia values ranged from 3.29 to 9.40mg/L in CS-HC-03SSG and CS-HC-05SSG-B, respectively. Prior to bioaccumulation testing, a small subsample was collected to evaluate porewater ammonia levels in the test sediments. Pre-test porewater ammonia levels ranged from 5.73 to 10.9mg/L total ammonia in the CS-HC-03SSG sediment and CS-HC-05SSG-B sediment, respectively (Table 4). Ten-day solid phase sediment toxicity tests with *H. azteca* and *C. tentans* were initiated on 09 November 1999; and the bioaccumulation test with *L. variegatus* was initiated on 29 October 1999. All tests with were initiated within the prescribed eight weeks, per ITM guidance. Test results are summarized in Table 2. Control survival in *H. azteca* (92.5%) met test acceptability criteria of 80% survival, whereas Reference (CS-HC-01R) survival (40%) did not meet the test acceptability criteria of 70%. There were no statistically significant effects in the *H. azteca* tests. Control survival (78.8%) and Reference (CS-HC-01R) survival (73.8%) in *C. tentans* met test acceptability criteria of 70% and 65%, respectively. Control ash free dry weight (1.48mg) in the test with *C. tentans* met the test acceptability criterion >0.6mg. Mean test mortality for *C. tentans* in the test sediment, CS-HC-02SSG, was statistically different and greater than 20% different (i.e. more than) from the mean reference response. In addition, the mean biomass for *C. tentans* in the test sediment, CS-HC-05SSG-B, was statistically significant and more than 40% different (i.e. less than) than the reference.

The test species, *H. azteca* and *C. tentans*, were also evaluated in reference toxicant tests with copper sulfate. Toxicant tests with *H. azteca* were exposed to nominal concentrations of 125, 250, 500, 1000, and 2000 Cu^{2+}µg/L. Toxicant tests with *C. tentans* were exposed to nominal concentrations of 250, 500, 1000, 2000, and 4000 Cu^{2+}µg/L. The LC_{50} for *H. azteca* (146.92µg/L) and *C. tentans* (388.9µg/L) were within two standard deviations of laboratory mean for each species (i.e., 477.8 ± 579.8µg/L for *H. azteca* and 834.0± 1413.6µg/L for *C. tentans*) indicating that test organisms were within the expected range of sensitivity to the reference toxicant.

Table 2: Summary of solid phase bioassay test results for Columbia Slough sediments.

Sample Name	H. azteca			C. tentans		
	% Survival (S.E.)			% Survival (S.E)	Mean Est. Indiv. Ash Free Dry wt. in mg (S.E)	
Control	92.5 (0.016)			78.8 (0.058)	1.48 (0.011)	
CS-HC-01R	40.0 (0.046)			73.8 (0.057)	0.89 (0.056)	
CS-HC-02SSG	80.0 (0.053)			28.8 (0.130)[1,3]	1.46 (0.285)	
CS-HC-03SSG	65.0 (0.057)			66.3 (0.092)	1.00 (0.081)	
CS-HC-04SSG	53.8 (0.053)			70.0 (0.073)	0.78 (0.084)	
CS-HC-05SSG-	26.3 (0.046)			63.8 (0.073)	0.33 (0.055)[1,4]	
Reference Toxicant	Copper Conc. (µg/L)	% Survival	LC_{50}	Copper Conc. (µg/L)	% Survival	LC_{50}
	Control	100.0	146.9 µg/L	Control	90.0	388.9 µg/L
	125	60.0		250	56.7	
	250	20.0		500	46.7	
	500	3.3		1000	0.0	
	1000	0.0		2000	0.0	
	2000	0.0		4000	0.0	

Attachment A
MEC Bioassay Evaluation

[1] = *t* – test significantly different ($p \leq 0.05$) relative to reference sediment.
[2] = survival > 15% reduced relative to reference (*H. azteca*).
[3] = survival > 20% reduced relative to reference (*C. tentans*).
[4] = reduction in biomass greater than 40% relative to reference.

Following the 28-day bioaccumulation test, *L. variegatus* were retrieved from the test sediment and measured. Test results are summarized in Table 3. Biomass of retrieved organisms ranged from 2.25 to 3.61grams in the Control and Reference (CS-HC-01R) sediments, respectively. Tissue samples were then frozen, and sent to Sound Analytical Systems for subsequent residue analysis.

Table 3: Summary of bioaccumulation test results for Columbia Slough sediments.

Sample Name	L. variegatus	
	Initial Weights grams	Mean Final Weights Grams (S.E.)
Control	5.00	2.91 (0.241)
CS-HC-01R	5.00	3.21 (0.170)
CS-HC-05SSG-B	5.00	2.80 (0.182)

Test conditions were within recommended limits for the *H. azteca* test species with the exception of temperature and pH. Temperature and pH were slightly outside the recommended ranges of 23±1°C (21.3 to 23.2°C); and 7.0 ± 1.0 (6.7 to 7.9), respectively. These excursions in temperature and pH were not significant (small and of short duration) and did not affect test results. Test conditions were within recommended limits for the *C. tentans* test species with the exception of temperature and dissolved oxygen. Temperature and dissolved oxygen were slightly outside the recommended ranges of 23±1°C (21.1 to 26.5°C); and >3.4mg/L (2.1 to 9.5mg/L), respectively. These excursions in temperature were not significant (small and of short duration) and did not affect test results. Aeration was begun on 17 November 1999 in order to rectify low dissolved oxygen concentrations. A summary of water quality during the 10-day solid phase tests with *H. azteca* and *C. tentans* is provided in Table 4. Test conditions were within recommended limits for the *L. variegatus* test species. Due to low initial dissolved oxygen readings, aeration was begun on 29 October 1999. A summary of water quality during the bioaccumulation test is provided in Table 5.

Attachment A
MEC Bioassay Evaluation

Table 4: Summary of Water Quality Data, Porewater Ammonia, and Overlying Ammonia for solid phase bioassay tests of Columbia Slough sediments.

H. azteca								
Sample Name	Water Quality Measurements				Porewater		Overlying	
	D.O mg/L (S.E.)	Temp. °C (S.E.)	Cond. MS/cm (S.E.)	pH Units (S.E.)	Initial mg/L	Final mg/L	Initial mg/L	Final mg/L
Control	7.5 (0.157)	21.6 (0.069)	0.30 (0.001)	7.6 (0.048)	0.063	0.0495	0.0049	0.239
CS-HC-01R	5.5 (0.132)	21.7 (0.065)	0.29 (0.001)	7.1 (0.018)	4.21	3.72	0.660	0.388
CS-HC-02SSG	5.6 (0.141)	21.7 (0.070)	0.29 (0.001)	7.0 (0.018)	5.20	4.12	0.837	0.666
CS-HC-03SSG	5.7 (0.169)	21.7 (0.065)	0.28 (0.001)	7.0 (0.021)	3.29	3.16	0.506	0.408
CS-HC-04SSG	5.5 (0.142)	21.7 (0.062)	0.28 (0.001)	7.0 (0.018)	6.70	4.97	0.964	0.951
CS-HC-05SSG-B	5.8 (0.123)	21.7 (0.063)	0.29 (0.001)	7.1 (0.014)	9.40	7.08	1.38	1.54
Reference Toxicant	8.4 (0.071)	22.4 (0.100)	0.30 (0.002)	7.7 (0.101)				
C. tentans								
Sample Name	Water Quality Measurements				Porewater		Overlying	
	D.O mg/L (S.E.)	Temp. °C (S.E.)	Cond. MS/cm (S.E.)	pH Units (S.E.)	Initial mg/L	Final mg/L	Initial mg/L	Final mg/L
Control	7.3 (0.413)	22.5 (0.228)	0.30 (0.001)	7.6 (0.061)	0.063	0.0495	0.0096	0.580
CS-HC-01R	6.4 (0.369)	22.5 (0.215)	0.29 (0.002)	7.2 (0.043)	4.21	3.72	0.750	0.214
CS-HC-02SSG	6.6 (0.358)	22.4 (0.219)	0.28 (0.002)	7.2 (0.049)	5.20	4.12	0.830	0.313
CS-HC-03SSG	6.8 (0.384)	22.5 (0.227)	0.28 (0.001)	7.2 (0.052)	3.29	3.16	0.566	0.712
CS-HC-04SSG	6.7 (0.438)	22.4 (0.219)	0.28 (0.001)	7.2 (0.065)	6.70	4.97	1.04	1.39
CS-HC-05SSG-B	6.4 (0.377)	22.5 (0.197)	0.29 (0.002)	7.2 (0.058)	9.40	7.08	1.74	2.05
Reference Toxicant	7.0 (0.294)	22.7 (0.079)	0.31 (0.004)	7.4 (0.044)				

Attachment A
MEC Bioassay Evaluation

Table 5: Summary of Water Quality Data, Pore Water Ammonia, and Overlying Ammonia for bioaccumulation tests of Lower Columbia River sediments.

L. variegatus							
Sample Name	Water Quality Measurements				Porewater Ammonia	Overlying Ammonia	
	D.O. % (S.E.)	Temp. °C (S.E.)	Cond. mS/cm (S.E.)	pH Units (S.E.)	Pretest mg/L	Initial mg/L	Final mg/L
Control	64.7 (2.590)	22.8 (0.096)	0.40 (0.003)	7.5 (0.037)	1.69	0.139	0.445
CS-HC-01R	79.7 (2.307)	23.1 (0.128)	0.28 (0.002)	7.2 (0.051)	5.73	1.44	0.0790
CS-HC-05SSG-B	78.5 (1.948)	23.2 (0.113)	0.28 (0.002)	7.2 (0.049)	10.9	2.58	0.0622

In summary, test results for solid phase tests with *C. tentans* indicated significant effects for survival in the test sediment CS-HC-02SSG, and significant effects on biomass in the test sediment CS-HC-05SSG-B. Results for solid phase tests with *H. azteca* could not be evaluated due to failure to meet test acceptability criteria for reference survival. Minimal biomass requirements for bioaccumulation tests with *L. variegatus* were met, and tissue residues were sent to Sound Analytical Systems for subsequent analysis. On the basis of these test results, it appears that the test sediments, CS-HC-02SSG and CS-HC-05SSG-B, are unsuitable for open water disposal in accordance with the one-hit failure rule described in the DMEF for the Lower Columbia River.

Thank you for the opportunity to conduct these tests on the Columbia Slough sediments. Should you have any questions regarding these test results or require additional information please contact me at 760-931-8081.

Sincerely,

David W. Moore, Ph.D.
Director of Toxicology and Chemistry
MEC Analytical Systems, Inc.

Attachment B
MEC Bioassay Evaluation

Bioaccumulation Test

The test sediment CS-HC-05SSG-B was evaluated in a twenty-eight day bioaccumulation test with the oligochaete, *Lumbriculus variegatus* to evaluate the potential for bioaccumulation of DDT and its metabolites. DDT tissue residues of organisms exposed to the test sediment were compared with tissue residues of animals exposed in parallel to the reference sediment CS-HC-01R. Test results are summarized in the table below.

Table X: Summary of bioaccumulation test results and analysis for the Columbia Slough sediment CS-HC-05SSG-B.

Sample I.D.	DDT Metabolite	Method Detection Limit (µg/kg)	Mean Tissue Conc. (µg/kg)	Steady State adjusted Tissue Concentration[1]	Comments
Control	4,4'-DDD	1.0	<0.70	N.A.	
	4,4'-DDE	1.0	<0.46	N.A.	
	4,4'DDT	1.0	<0.59	N.A.	
Reference CS-HC-01R	4,4'-DDD	1.0	<0.65	N.A.	
	4,4'-DDE	1.0	2.5	4.2	Lowest No Observable Effect Dose (NOED) reported in the ERED for a freshwater invertebrate (time of development in the midge, *C. tentans*) is 3,750 µg/Kg.
	4,4'DDT	1.0	0.48	0.8	Lowest No Observable Effect Dose (NOED) reported in the ERED for a freshwater invertebrate (mortality in the Dragonfly) is 14.4 µg/Kg
CS-HC-05SSG-B	4,4'-DDD	1.0	<0.77	N.A.	
	4,4'-DDE	1.0	0.1 (0.55 in one of 5 replicates)	0.29	Lowest No Observable Effect Dose (NOED) reported in the ERED for a freshwater invertebrate (time of development in the midge, *C. tentans*) is 3,750 µg/Kg.
	4,4'DDT	1.0	<0.64	N.A	

[1]Steady-state tissue concentrations were estimated based on a log K_{ow} value of 5.7 (from table 9-5 of the ITM) for DDT and DDE and using the function for the expected proportion of steady state concentration at 28-days developed by McFarland (1994) (figure 6-1 in the ITM).

Attachment B
MEC Bioassay Evaluation

Results of the tissue analysis indicate that measured DDT tissue residues were nearly all below the method detection limit (1.0µg/kg) in organisms exposed to the test sediment. All measured concentrations in both the test and reference organisms were well below the FDA action limit of 5,000 µg/kg (given as the sum of DDE & DDT).

While a trace amount of the metabolite 4,4′-DDE was measured at a level close to the sample detection limit in a single replicate of the test sediment exposed organisms, the measured tissue concentration of 4,4′-DDE (0.55µg/kg.) was less than the mean reference value of 2.5µg/kg and substantially less than the lowest relevant No Observable Effect Dose (NOED) (3,750 µg/kg) reported in the Environmental Residue-Effects Database (ERED).

Animals exposed to the reference sediment had measurable levels of 4,4′-DDE and 4,4′-DDT with mean values of 2.5µg/kg and 0.48 µg/kg, respectively. Both of these values were substantially less than the lowest relevant NOEDs reported in the ERED even after adjusting to an estimate of the steady-state concentration. The metabolite, 4,4′-DDD was not detected in either the reference or the test sediment exposed organisms.

Since DDT is known to biomagnify in aquatic food webs we used trophic transfer coefficients from the published literature to estimate potential risk to higher trophic organisms (i.e., fish consuming benthic infauna, piscivorous birds, and humans consuming fish). A biomagnification factor (BMF) of 30 was used to estimate the resultant tissue concentration in fish consuming *L. variegatus* with the measured DDT residues reported herein. This BMF estimate was based on work by Rasmussen et al. (1990) and Wang & Simpson (1996) which suggests a BMF of 30 to go from a planktonic prey item (i.e., artemia) to lake trout. Using this factor, the resultant tissue concentration in fish subsisting entirely on *L. variegatus* with a measured body burden of 5 µg/Kg ΣDDT (approximating the highest concentration reported herein) would be 150 µg/Kg (whole body), well below the lowest relevant effect dose for a freshwater fish reported in the ERED (e.g., a value of 1600 µg/Kg for 4.4'- DDE resulted in reduced growth in Lake Trout). This value also appears to be comparable to fish tissue residue values (10 – 470 µg/Kg p,p' DDE; <10 – 30 µg/Kg p,p' DDT) reported for a variety of sites in the Columbia River in 1991 (personal communication Chee Choy, City of Portland, Bureau of Env. Services). We also estimated the concentration in a piscivorous raptor's egg in order to evaluate the potential risk for eggshell thinning. To generate this estimate we used a BMF of 22 (calculated by Giesy et al. [1995] for Bald Eagles) to go from the estimated fish tissue concentration of 150 µg/Kg to a projected egg residue of 3,300 µg/Kg. This estimated egg residue value is less than the no observable effect concentration of 3,600 µg/Kg in eggs reported by Wiemeyer et al. for the Bald Eagle (1993). To evaluate the estimated whole body fish tissue concentration (for human health consumption concerns) the estimated concentration was adjusted to account for the conversion from a whole body concentration to a filet using a factor of 0.5 (i.e. assumes approximately half of the whole body concentration is in the filet, generally a factor of 0.3 is used). After adjustment the resulting tissue residues in the edible portion of the fish tissue was estimated to be 75 µg/Kg ΣDDT. This value is in line with residues reported as part of the FDA's latest published annual market survey (1998) for freshwater fish filets obtained from markets which resulted in values ranging between 0 and 51 µg/Kg ΣDDT (http://vm.cfsan.fda.gov/~download/ pes98db.html).

Attachment B
MEC Bioassay Evaluation

Based on this analysis, the measured tissue residues in the test sediment exposed organisms represents little to no risk to wildlife or humans. A similar evaluation of tissue residues in reference exposed organisms (which were higher than test sediment exposed organisms) showed that the measured tissue residues do not represent a significant risk to benthic infauna. Additionally, based on the conservative screening level assessment provided above, these measured DDT residues in reference exposed organisms appear to represent little to no risk to higher trophic organisms (predatory fish and Bald Eagles). Finally a comparison of estimated fish tissue residues (derived from reference site exposed organisms) results in human health risks comparable to that for fish obtained from the market.

References

Giesy et al. (1995). Arch. Environ. Contam. Toxicol. 29, 309-321.

Rasmussen et al. (1990). Can. J. Fish. Aquat. Sci. 47, 2030.

USEPA/ USACE 1998. Inland Testing Manual. EPA-823-B-98-004.

Wang and Simpson (1996). Bull. Environ. Contam. Toxicol. 56:888-895.

Wiemeyer et al. (1993). Arch. Environ. Contam. Toxicol. 24, 213-227.

Attachment C - Multnomah County Drainage District
Presentation to the Dredge Material Management Team

Columbia Slough Meandering Channel/Wetland Benches Project

Fact Sheet

Project Purpose

Creation of a meandering channel over various segments of a 10-mile stretch of the mainstem of the Middle and Upper Columbia Slough. The intended function of the channel deepening is to increase velocities to improve water quality during the low flow season and to provide wildlife and wetland habitat.

Project Description

The U.S Corps of Engineers is conducting a General Investigation (GI) Feasibility Study to evaluate a meandering channel in the Slough mainstem for water quality, wildlife and wetland enhancement benefits. Dredging would be conducted to an elevation of approximately 3 feet and the dredged material would be used to create wetland benches. These benches would be vegetated to support wildlife. Side casting would be used to create the meanders during low-water periods. The Multnomah County Drainage District (MCDD) which is responsible for maintaining the Slough channels would obtain the required 404/401 permits for conducting this project.

Project Background

Historical Chemistry Data Review

Historical data were reviewed to evaluate potential sediment issues related to inwater disposal (side casting) of Slough sediments. Numerous surface samples have been taken in the Slough mainstem on various dates and numerous locations. Most of the analyses were below the screening levels (SLs) of the regional Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF). Table 1 shows the exceedances of the SLs. Those analyses exceeding the SLs were 4 heavy metals, 3 phenol groups, 2 phthalate groups, 1 alcohol and 1 pesticide.

Sediment Sampling

After review of these data, the U.S Corps of Engineers conducted additional sampling to characterize the sediment of portions of the middle and upper Columbia Slough mainstem.

The US Army Corps of Engineers, Portland District personnel collected gravity core samples on May 18-19, 1999. The study area was divided into 8 sampling areas (see attached figure). The eight sampling composite areas were selected to give balanced coverage to the full-length study. Twenty-two individual cores were collected and composited with 3 samples per area (except area 7, one sample only). The eight composite core samples were divided, with the top representing the dredging prism and the bottom 6" to 12", representing the

"newly exposed surface" after dredging is completed. Samples were analyzed for the following:

- Physical and Volatile Solids
- Metals and Total Organic Carbon (TOC)
- Pesticide/PCBs, Phenols, Phthalates and Misc. Extractables
- Polynuclear Aromatic Hydrocarbons (PAHs)

With few exceptions, the newly exposed surface has chemicals of concern at lower levels than the material in the dredging prism. The pesticide DDT was the only compound found in excess of the SL (6.9 ug/kg). Of 16 samples analyzed for DDT, 10 exceeded the SL with levels ranging from 7.1 to 51.3 ug/kg (Table 2). The bioaccumulation level of concern is 50 µg/kg; only one sample (CS-GC-08A in the dredging prism) exceeded this level at 51.3 µg/kg.

Biological Testing

Tier III biological testing was recommended to characterize potential biological effects from inwater disposal because of the DDT sediment concentrations greater than the SL and bioaccumulation level of concern. A list of dredging scenarios was developed from preliminary discussions of the meandering channel design to aid in determining what kind of bioassay sampling should be conducted. Table 3 provides information on proposed dredge locations and volumes, and the associated DDT concentrations in each area.

A review team, including DEQ, the Corps, the City of Portland, and MCDD recommended that five composite samples be collected, one each from Areas 1, 3, 4, 5, and 8. Each composite sample was comprised of three sediment samples collected from each area with a gravity core. The bioassays consisted of tests for 2 species (Amphipod – *Hyalella azteca* 10-day survival test and Midge – *Chironomus tentans* 10-day survival and growth test). The bioaccumulation test was conducted on one species (Oligocheate – *Limbriculus variegatus* 28-day tissue tesidue test). The testing is summarized below.

Area	Composite Bioassay Test	Composite Bioaccumulation Test	Composite DDT and Grain Size Analyses	# Samples/ composite
1[a]	1	1	1	3
2	--	--	--	None
3	1	--	1	3
4	1	--	1	3
5	1	--	1	3
6	--	--	--	None
7	--	--	--	None
8	1	1	1	3
[a] Reference site				

The results of the acute and chronic testing are summarized in Table 4. The amphipod results were inconclusive because the reference area failed to meet the acceptable survival criterion. The results of the midge bioassays indicated significant effects for survival in one sample (Area 3) and for growth in one sample (Area 8), but the results were somewhat inconclusive. Several things may have contributed to inconclusive results. Temperature and pH were slightly outside the recommended ranges. Ammonia levels, while not lethal, may have caused stress in some samples. It was noted that the reference and test sediments had significant amount of woody debris (small wood chips); wood chips contain resin alkaloids that are known to be acutely lethal to many benthic invertebrate species. None of these factors can be determined to be conclusive for the outcome of the bioassays.

The bioaccumulation testing for Area 8 was evaluated by comparing DDT tissue residues of organisms exposed to the test sediment with tissue residues of animals exposed in parallel to the reference sediment CS-HC-01R. Results of the tissue analysis indicate that measured DDT tissue residues were nearly all below the method detection limit (1.0 µg/kg) in organisms exposed to the test sediment (Table 5). All measured concentrations in both the test and reference organisms were well below the FDA action limit of 5,000 µg/kg (given as the sum of DDE & DDT).

Since DDT is known to biomagnify in aquatic food webs, trophic transfer coefficients from the published literature were used to estimate potential risk to higher trophic organisms (i.e., fish consuming benthic infauna, piscivorous birds, and humans consuming fish). A biomagnification factor (BMF) of 30 was used to estimate the resultant tissue concentration in fish consuming *L. variegatus* with the measured DDT residues. Based on this analysis, the measured tissue residues in the test sediment exposed organisms represents little to no risk to wildlife or humans. A similar evaluation of tissue residues in reference exposed organisms (which were higher than test sediment exposed organisms) showed that the measured tissue residues do not represent a significant risk to benthic infauna. Additionally, based on the conservative screening level assessment provided above, these measured DDT residues in reference exposed organisms appear to represent little to no risk to higher trophic organisms (predatory fish and Bald Eagles). Finally a comparison of estimated fish tissue residues (derived from reference site exposed organisms) results in human health risks comparable to that for fish obtained from the market.

Next Steps

The chemical testing conducted by the Corps in May 1999 indicated that the only contaminant exceeding the DMEF screening levels was DDT. Subsequent biological testing indicated no risk for bioaccumulation but the bioassay testing was somewhat inconclusive.

The project team proposes to the DMMT that this project be allowed to proceed based on 40 CFR 230.60 (c):

> "To reach the determinations in Sec. 230.11 involving potential effects of the discharge on the characteristics of the disposal site, the narrative guidance in subparts C through F shall be used along with the general evaluation procedure in Sec. 230.**60** and, if necessary, the chemical and biological testing sequence in Sec. 230.61. Where the discharge site is adjacent to the extraction site and subject to the same sources of

contaminants, and materials at the two sites are substantially similar, the fact that the material to be discharged may be a carrier of contaminants is not likely to result in degradation of the disposal site. In such circumstances, when dissolved material and suspended particulates can be controlled to prevent carrying pollutants to less contaminated areas, testing will not be required." [Full text of 230.60 provided in Attachment A]

The 40 CFR 230.11 provides guidance of factual determinations for making findings of compliance or non-compliance with the restrictions on discharge [Full text of 230.11 provided in Attachment B]. The determinations of effects of each proposed discharge shall include the following:

(a) **Physical substrate determinations.** The purpose of this evaluation is determine if changes outside of the disposal site may occur as a result of erosion, slumpage, or other movement of the discharged material.

The project incorporates stabilization of the side-casted material with vegetation to prevent erosion or other movement of the dredged material.

(b) **Water circulation, fluctuation, and salinity determinations**. Requires determination of the nature and degree of effect that the proposed discharge will have individually and cumulatively on water, current patterns, circulation including downstream flows, and normal water fluctuation.

The project is designed to improve water circulation and quality.

(c) **Suspended particulate/turbidity determinations**. Requires determination of the nature and degree of effect that the proposed discharge will have, individually and cumulatively, in terms of potential changes in the kinds and concentrations of suspended particulate/turbidity in the vicinity of the disposal site.

Measures will be taken to minimize suspension of particulates, including stopping flow in the Slough during the activity and stabilization of the dredged benches after placement. Because MCDD can control flows and water levels within the project area, effective controls during construction of the project can be implemented. Long-term benefits of the project include increased solids retention by vegetation on the benches.

(d) **Contaminant determinations**. Requires determination of the degree to which the material proposed for discharge would introduce, relocate, or increase contaminants.

Proposed project will not increase contaminant, since material is being placed within the general area that it is dredged. Even if all material was disposed upland, the long-term redeposition of the same contaminants from the watershed is anticipated in the Slough.

(e) Aquatic ecosystem and organism determinations. Determine the nature and degree of effect that the proposed discharge will have, both individually and cumulatively, on the structure and function of the aquatic ecosystem and organisms.

Project designed to enhance structure and function of aquatic and wetland ecosystems.

Table 1. Historical Columbia Slough Sediment Project Data[1]

Sampling Area	Sample ID	Parameter	VALUE	Q	LCRMA Screening Levels[2]	Value Exceeds LCRMA	UNITS	DL	PQL
1	CSUTS002100	4-Methylphenol	3300	E	670	x	ug/kg-dry	28	87
	CSUTS002100-DL	4-Methylphenol	3100		670	x	ug/kg-dry	55	170
	CSURS014300	Total DDT	12.3		6.9	X	ug/kg-dry	NA	NA
	CSURS025400	Total DDT	8.5		6.9	X	ug/kg-dry	NA	NA
	CSURS068500	Total DDT	12.2		6.9	X	ug/kg-dry	NA	NA
	CSURS068500-DL	Total DDT	9		6.9	X	ug/kg-dry	NA	NA
	CSURS110200	Total DDT	15.6		6.9	X	ug/kg-dry	NA	NA
	CSURS123500	Total DDT	13.1		6.9	X	ug/kg-dry	NA	NA
	CSUTS001500	Total DDT	13.8		6.9	X	ug/kg-dry	NA	NA
2	CSURS235500	Benzyl Alcohol	65	JM	57	x	ug/kg-dry	22	140
	CSURS175200	Total DDT	24.3		6.9	X	ug/kg-dry	NA	NA
	CSURS175200-DL	Total DDT	17.2		6.9	X	ug/kg-dry	NA	NA
	CSURS195400	Total DDT	9.4		6.9	X	ug/kg-dry	NA	NA
	CSURS212100	Total DDT	23		6.9	X	ug/kg-dry	NA	NA
	CSURS235500	Total DDT	44.1		6.9	X	ug/kg-dry	NA	NA
	CSURS265200	Total DDT	9.1		6.9	X	ug/kg-dry	NA	NA
	CSURS294500	Total DDT	17.7		6.9	X	ug/kg-dry	NA	NA
	CSURS308100	Total DDT	25.8		6.9	X	ug/kg-dry	NA	NA
	CSURS329400	Total DDT	7.4		6.9	X	ug/kg-dry	NA	NA
	CSUTS302500	Total DDT	9.8		6.9	X	ug/kg-dry	NA	NA
3	CSURS436400	4-Methylphenol	1400		670	x	ug/kg-dry	47	150
	CSURS416100	Total DDT	18.4		6.9	X	ug/kg-dry	NA	NA
	CSURS436400	Total DDT	9.2		6.9	X	ug/kg-dry	NA	NA
4	CSURS485200	2,4-Dimethylphenol	1000		29	x	ug/kg-dry	150	460
	CSURS485200	2-Methylphenol	460		63	x	ug/kg-dry	85	270
	CSURS485200	Benzyl Alcohol	1300		57	x	ug/kg-dry	44	290
	CSURS496400	4-Methylphenol	1200		670	x	ug/kg-dry	22	70
	CSURS496400	Total DDT	15.5		6.9	X	ug/kg-dry	NA	NA
	CSURS533300	Total DDT	15		6.9	X	ug/kg-dry	NA	NA
	CSURS573200	Total DDT	17.5		6.9	X	ug/kg-dry	NA	NA
	CSURS585500	Total DDT	9.2		6.9	X	ug/kg-dry	NA	NA
	CSURS604500	Total DDT	8		6.9	X	ug/kg-dry	NA	NA
	CSURS623200	Total DDT	27.9		6.9	X	ug/kg-dry	NA	NA
	CSUTS501300	Total DDT	17.9		6.9	X	ug/kg-dry	NA	NA

Attachment C - Multnomah County Drainage District
Presentation to the Dredge Material Management Team

Table 1. Historical Columbia Slough Sediment Project Data[1]

Sampling Area	Sample ID	Parameter	VALUE	Q	LCRMA Screening Levels[2]	Value Exceeds LCRMA	UNITS	DL	PQL
	CSUTS602300	Total DDT	23.1		6.9	X	ug/kg-dry	NA	NA
	CSUTS502100	4-Methylphenol	880		670	x	ug/kg-dry	16	52
	CSURS604500	4-Methylphenol	800		670	x	ug/kg-dry	27	85
5	CSSTS002500	Lead	510		450	x	mg/kg-dry		
	CSSTS002500	Zinc	722		410	x	mg/kg-dry		
6	CSSTS101500	Bis(2-Ethylhexyl)Phthalate	11000	E	8300	x	ug/kg-dry	10	32
	CSSTS101500-DL	Bis(2-Ethylhexyl)Phthalate	38000		8300	x	ug/kg-dry	310	960
	CSSRS119300	Mercury	0.51		0.41	x	mg/kg-dry		
	CSSRS058100	Total DDT	13.7		6.9	X	ug/kg-dry	NA	NA
	CSSRS093200	Total DDT	36.2		6.9	X	ug/kg-dry	NA	NA
	CSSTS102500	Bis(2-Ethylhexyl)Phthalate	40000	E	8300	x	ug/kg-dry	170	550
	CSSTS102500-DL	Bis(2-Ethylhexyl)Phthalate	31000		8300	x	ug/kg-dry	350	1100
	CSSTS102500	Butylbenzyl Phthalate	1100	M	970	x	ug/kg-dry	96	300
	CSSTS102500	Cadmium	36		5.1	x	mg/kg-dry		
	CSSTS102500	Lead	510		450	x	mg/kg-dry		
	CSSTS102500	Zinc	1320		410	x	mg/kg-dry		
	CSSTS102501	Bis(2-Ethylhexyl)Phthalate	59000	E	8300	x	ug/kg-dry	130	400
	CSSTS102501-DL	Bis(2-Ethylhexyl)Phthalate	32000		8300	x	ug/kg-dry	1300	4000
	CSSTS102501	Cadmium	84		5.1	x	mg/kg-dry		
	CSSTS102501	Lead	520		450	x	mg/kg-dry		
	CSSTS102501	Zinc	1310		410	x	mg/kg-dry		
8	EDSTS201600	Dieldrin	0.02		0.01	x	mg/kg-dry		0.01
	CSSRS220400	4-Methylphenol	790		670	x	ug/kg-dry	26	83
	EDSTS202600	Dieldrin	0.02		0.01	x	mg/kg-dry		0.01
	CSSRS205300	Total DDT	9.9		6.9	X	ug/kg-dry	NA	NA
	CSSRS220400	Total DDT	16.6		6.9	X	ug/kg-dry	NA	NA
	CSSTS202500	Bis(2-Ethylhexyl)Phthalate	3800	E	8300		ug/kg-dry	17	54
	CSSTS202500-DL	Bis(2-Ethylhexyl)Phthalate	16000		8300	x	ug/kg-dry	140	430

[1] Data from the City of Portland: Columbia Slough Sediment Project, Screening Level Risk Assessment Report, Feb.1995. Only exceedances are shown.

[2]Source: USACE. 1998. Dredged Material Evaluation Framework, Lower Columbia River Management Area Draft.

Screening level = Concentrations at or below which there is no reason to believe that dredged material disposal would result in unacceptable adverse effects due to toxicity measured by sediment bioassays (suitable for aquatic disposal without the need for biological testing). These screening values were developed for the marine environment; freshwater values are under development.

Notes:

No qualifier definitions were given with database.

Table 2. Columbia Slough GI Study Pesticides (ug/kg) Results, Sampled May 18-19, 1999

Sample I.D.	4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT	Aldrin	Dieldrin	Alpha-BHC	Delta-BHC	Endosulfan 1	Endrin	Endrin aldehyde	Hepta chlor	Hepta chlor epoxide
CS-GC-01A	<0.58	2.1	<2.0	2.1	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-A (DUP--01A)	1.8	3.5	<2.0	5.2	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-01B	<0.33	<0.69	<2.4	ND	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-02A	2.8	2.5	<1.8	5.3	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-02B	<0.26	<0.54	<1.9	ND	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-03A	4.3	6.5	<2.2	**10.8**	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-03B	1.9	2.8	<1.8	**4.7**	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-04A	5.5	8.9	<2.1	**14.4**	<0.12	<0.11	<0.12	<0.12	1.2	<0.19	12	<0.16	<0.26
CS-GC-04B	1.7	1.3	<1.7	**3.0**	<0.12	<0.11	<0.12	0.37	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-05A	14	17	<2.4	**31.0**	1.6	0.94	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	0.46
CS-GC-05B	3.9	7.4	<2.1	**11.3**	<0.12	<0.11	<0.12	<0.12	<0.51	<0.19	<1.4	<0.16	<0.26
CS-GC-06A	6.3	8.6	<2.4	**14.9**	<0.12	<0.11	0.39	<0.12	0.72	<0.19	<1.4	<0.16	<0.26
CS-GC-06B	2.8	4.3	<1.7	**7.1**	<0.12	<0.11	<0.12	0.24	<0.51	<0.19	<1.4	0.17	<0.26
CS-GC-07A	14	29	<3.2	**43.0**	<0.12	<0.11	0.71	<0.12	<0.51	<0.19	5.1	<0.16	0.58
CS-GC-07B	16	22	3.9	**41.9**	<0.12	<0.11	<0.12	<0.12	1.1	<0.19	<1.4	<0.16	<0.26
CS-GC-08A	21	25	5.3	**51.3**	<0.12	1.2	0.47	<0.12	<0.51	1.2	<1.4	<0.16	1.8
CS-GC-08B	12	16	5.5	**33.5**	<0.12	1.0	0.55	<0.12	<0.51	0.78	2.9	<0.16	1.7
Screen level (SL)	DDD + DDE + DDT =			**6.9**	10	10	*	*	*	*	*	*	*
Mean	6.4	9.2	0.9	**16.5**	0.94	0.18	0.04	0.04	0.14	0.07	1.18	0.01	0.26
Maximum	21	25	5.5	**51.3**	1.6	1.2	0.71	0.37	1.2	1.2	12	0.17	1.8

Values detected for DDT were confirmed with second column.

* SL has not been established.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Attachment C - Multnomah County Drainage District
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Table 3. Preliminary Meandering Channel Design Summary						
Area	Location	Proposed Dredging	Dredge Volume (cubic yards)	Inwater Disposal?	Dredging Prism DDT (ug/kg)	Bottom of Core DDT (ug/kg)
1	MCDD #1 to Whitaker Slough	Dredge to elevation 0ft	N/A	Yes	2.1	ND
2	Whitaker Slough to 78th Avenue	Dredge to elevation 0ft	N/A	Yes	5.3	ND
	78th to 82nd Avenue	Dredge to elevation 2ft	N/A	Yes	5.3	ND
3	82nd Avenue to 92nd Avenue	Dredge to elevation 2ft	13,000	Yes	10.8	4.7
4	92nd Avenue to I-205	Dredge to elevation 2ft	38,000	Yes	14.4	3.0
	I-205 to 122nd Avenue					
	122nd Avenue to 138th Avenue					
5	138th Avenue to Mid-dike levee	Dredge to elevation 2ft	28,300	Yes	31	11.3
	Mid-dike levee to 148th Avenue	Dredge to elevation 3ft				
	148th Avenue to 158th Avenue	Dredge to elevation 2ft				
6	158th Avenue to Four Corners	None	N/A	No	14.9	7.1
7	Four Corners to MCDD #4	None	N/A	No	43	41.9
8	Four Corners to Bridge B	None	N/A	No	51.3	33.5
	Bridge B to Bridge C	Dredge to elevation 5ft	13,000	Yes	51.3	33.5
	Bridge C through vegetated area east of 185th Avenue bridge	None		No	51.3	33.5
	East of 185th Avenue to Fairview Lake	Dredge to elevation 5ft		Yes	51.3	33.5

ND = Not detected
N/A = Non-Applicable

Table 4. Summary of Acute and Chronic Bioassays									
Area	Sample	H. azteca	C. tentans		% fines	% TOC	Initial Porewater NH3 (mg N/L)	ΣDDT (ug/kg)	Organic Carbon (ug/g)
		% Survival	% Survival	Growth (mg)					
	Control	92.5 (0.016)	78.8 (0.058)	1.48 (0.011)	2	0.02	0.06	N.A.	N.A.
1	CS-HC-01R	40.0 (0.046)	73.8 (0.057)	0.89 (0.056)	44	1.2	4.2	6.1	0.5
3	CS-HC-02SSG	80.0 (0.053)	28.8 (0.130)	1.46 (0.285)	50	1.6	5.2	2.4	0.15
4	CS-HC-03SSG	65.0 (0.057)	66.3 (0.092)	1.00 (0.081)	65	1.6	3.3	2.7	0.17
5	CS-HC-04SSG	53.8 (0.053)	70.0 (0.073)	0.78 (0.084)	91	2.3	6.7	5.5	0.235
8	CS-HC-05SSG-B	26.3 (0.046)	63.8 (0.073)	0.33 (0.055)	65	2.7	9.4	9.8	0.365

Table 5: Summary of bioaccumulation test results and analysis for the Columbia Slough sediment CS-HC-05SSG-B.

Sample I.D.	DDT Metabolite	Method Detection Limit (µg/kg)	Mean Tissue Conc. (µg/kg)	Steady State adjusted Tissue Concentration[1]	Comments
Control	4,4'-DDD	1.0	<0.70	N.A.	
	4,4'-DDE	1.0	<0.46	N.A.	
	4,4'DDT	1.0	<0.59	N.A.	
Reference CS-HC-01R	4,4'-DDD	1.0	<0.65	N.A.	
	4,4'-DDE	1.0	2.5	4.2	Lowest No Observable Effect Dose (NOED) reported in the ERED for a freshwater invertebrate (time of development in the midge, *C. tentans*) is 3,750 µg/Kg.
	4,4'DDT	1.0	0.48	0.8	Lowest No Observable Effect Dose (NOED) reported in the ERED for a freshwater invertebrate (mortality in the Dragonfly) is 14.4 µg/Kg
CS-HC-05SSG-B	4,4'-DDD	1.0	<0.77	N.A.	
	4,4'-DDE	1.0	0.1 (0.55 in one of 5 replicates)	0.29	Lowest No Observable Effect Dose (NOED) reported in the ERED for a freshwater invertebrate (time of development in the midge, *C. tentans*) is 3,750 µg/Kg.
	4,4'DDT	1.0	<0.64	N.A	

[1]Steady-state tissue concentrations were estimated based on a log K_{ow} value of 5.7 (from table 9-5 of the ITM) for DDT and DDE and using the function for the expected proportion of steady state concentration at 28-days developed by McFarland (1994) (figure 6-1 in the ITM).

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[Code of Federal Regulations]
[Title 40, Volume 17, Parts 190 to 259]
[Revised as of July 1, 1999]
From the U.S. Government Printing Office via GPO Access
[**CITE: 40CFR230.60**]

[Page 260-261]
TITLE 40--PROTECTION OF ENVIRONMENT AGENCY (CONTINUED)

PART 230--SECTION 404(b)(1) GUIDELINES FOR SPECIFICATION OF DISPOSAL SITES FOR DREDGED OR FILL MATERIAL--Table of Contents

Subpart G--Evaluation and Testing Sec.
230.**60** General evaluation of dredged or fill material.

The purpose of these evaluation procedures and the chemical and biological testing sequence outlined in Sec. 230.61 is to provide information to reach the determinations required by Sec. 230.11. Where the results of prior evaluations, chemical and biological tests, scientific research, and experience can provide information helpful in making a determination, these should be used. Such prior results may make new testing unnecessary. The information used shall be documented. Where the same information applies to more than one determination, it may be documented once and referenced in later determinations.

(a) If the evaluation under paragraph (b) indicates the dredged or fill material is not a carrier of contaminants, then the required determinations pertaining to the presence and effects of contaminants can be made without testing. Dredged or fill material is most likely to be free from chemical, biological, or other pollutants where it is composed primarily of sand, gravel, or other naturally occurring inert material. Dredged material so composed is generally found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels. However, when such material is discolored or contains other indications that contaminants may be present, further inquiry should be made.

(b) The extraction site shall be examined in order to assess whether it is sufficiently removed from sources of pollution to provide reasonable assurance that the proposed discharge material is not a carrier of contaminants. Factors to be considered include but are not limited to:

(1) Potential routes of contaminants or contaminated sediments to the extraction site, based on hydrographic or other maps, aerial photography, or other materials that show watercourses, surface relief, proximity to tidal movement, private and public roads, location of buildings, municipal and industrial areas, and agricultural or forest lands.

(2) Pertinent results from tests previously carried out on the material at the extraction site, or carried out on similar material for other permitted projects in the vicinity. Materials shall be considered similar if the sources of contamination, the physical configuration of the sites and the sediment composition of the materials are comparable, in light of water circulation and stratification, sediment accumulation and general sediment characteristics. Tests from other sites may be relied on only if no changes have occurred at the extraction sites to render the results irrelevant.

(3) Any potential for significant introduction of persistent pesticides from land runoff or percolation;

(4) Any records of spills or disposal of petroleum products or substances designated as hazardous under section 311 of the Clean Water Act (See 40 CFR part 116);

(5) Information in Federal, State and local records indicating significant introduction of pollutants from industries, municipalities, or other sources, including types and amounts of waste materials discharged along the potential routes of contaminants to the extraction site; and

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(6) Any possibility of the presence of substantial natural deposits of minerals or other substances which could be released to the aquatic environment in harmful quantities by man-induced discharge activities.

(c) To reach the determinations in Sec. 230.11 involving potential effects of the discharge on the characteristics of the disposal site, the narrative guidance in subparts C through F shall be used along with the general evaluation procedure in Sec. 230.**60** and, if necessary, the chemical and biological testing sequence in Sec. 230.61. Where the discharge site is adjacent to the extraction site and subject to the same sources of contaminants, and materials at the two sites are substantially similar, the fact that the material to be discharged may be a carrier of contaminants is not likely to result in degradation of the disposal site. In such circumstances, when dissolved material and suspended particulates can be controlled to prevent carrying pollutants to less contaminated areas, testing will not be required.

(d) Even if the Sec. 230.**60**(b) evaluation (previous tests, the presence of polluting industries and information about their discharge or runoff into waters of the U.S., bioinventories, etc.) leads to the conclusion that there is a high probability that the material proposed for discharge is a carrier of contaminants, testing may not be necessary if constraints are available to reduce contamination to acceptable levels within the disposal site and to prevent contaminants from being transported beyond the boundaries of the disposal site, if such constraints are acceptable to the permitting authority and the Regional Administrator, and if the potential discharger is willing and able to implement such constraints. However, even if tests are not performed, the permitting authority must still determine the probable impact of the operation on the receiving aquatic ecosystem. Any decision not to test must be explained in the determinations made under Sec. 230.11.

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TITLE 40--PROTECTION OF ENVIRONMENT AGENCY (CONTINUED)

PART 230--SECTION 404(b)(1) GUIDELINES FOR SPECIFICATION OF DISPOSAL SITES FOR DREDGED OR FILL MATERIAL--Table of Contents

Subpart B--Compliance With the Guidelines

Sec. 230.**11** Factual determinations.

The permitting authority shall determine in writing the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment in light of subparts C through F. Such factual determinations shall be used in Sec. 230.12 in making findings of compliance or non-compliance with the restrictions on discharge in Sec. 230.10. The evaluation and testing procedures described in Sec. 230.60 and Sec. 230.61 of subpart G shall be used as necessary to make, and shall be described in, such determination. The determinations of effects of each proposed discharge shall include the following:

(a) Physical substrate determinations. Determine the nature and degree of effect that the proposed discharge will have, individually and cumulatively, on the characteristics of the substrate at the proposed disposal site. Consideration shall be given to the similarity in particle size, shape, and degree of compaction of the material proposed for discharge and the material constituting the substrate at the disposal site, and any potential changes in substrate elevation and bottom contours, including changes outside of the disposal site which may occur as a result of erosion, slumpage, or other movement of the discharged material. The duration and physical extent of substrate changes shall also be considered. The possible loss of environmental values (Sec. 230.20) and actions to minimize impact (subpart H) shall also be considered in making these determinations. Potential changes in substrate elevation and bottom contours shall be predicted on the basis of the proposed method, volume, location, and rate of discharge, as well as on the individual and combined effects of current patterns, water circulation, wind and wave action, and other physical factors that may affect the movement of the discharged material.

(b) Water circulation, fluctuation, and salinity determinations. Determine the nature and degree of effect that the proposed discharge will have individually and cumulatively on water, current patterns, circulation including downstream flows, and normal water fluctuation. Consideration shall be given to water chemistry, salinity, clarity, color, odor, taste, dissolved gas levels, temperature, nutrients, and eutrophication plus other appropriate characteristics. Consideration shall also be given to the potential diversion or obstruction of flow, alterations of bottom contours, or other significant changes in the hydrologic regime. Additional consideration of the possible loss of environmental values (Secs. 230.23 through 230.25) and actions to minimize impacts (subpart H), shall be used in

making these determinations. Potential significant effects on the current patterns, water circulation, normal water fluctuation and salinity shall be evaluated on the basis of the proposed method, volume, location, and rate of discharge.

(c) Suspended particulate/turbidity determinations. Determine the nature and degree of effect that the proposed discharge will have, individually and cumulatively, in terms of potential changes in the kinds and concentrations of suspended particulate/turbidity in the vicinity of the disposal site. Consideration shall be given to the grain size of the material proposed for discharge, the shape and size of the plume of suspended particulates, the duration of the discharge and resulting plume and whether or not the potential changes will cause violations of applicable water quality standards. Consideration should also be given to the possible loss of environmental values (Sec. 230.21) and to actions for minimizing impacts (subpart H). Consideration shall include the proposed method, volume, location, and rate of discharge, as well as the individual and combined effects of current patterns, water circulation and fluctuations, wind and wave action, and other physical factors on the movement of suspended particulates.

(d) Contaminant determinations. Determine the degree to which the material proposed for discharge will introduce, relocate, or increase contaminants. This determination shall consider the material to be discharged, the aquatic environment at the proposed disposal site, and the availability of contaminants.

(e) Aquatic ecosystem and organism determinations. Determine the nature and degree of effect that the proposed discharge will have, both individually and cumulatively, on the structure and function of the aquatic ecosystem and organisms. Consideration shall be given to the effect at the proposed disposal site of potential changes in substrate characteristics and elevation, water or substrate chemistry, nutrients, currents, circulation, fluctuation, and salinity, on the recolonization and existence of indigenous aquatic organisms or communities. Possible loss of environmental values (Sec. 230.31), and actions to minimize impacts (subpart H) shall be examined. Tests as described in Sec. 230.61 (Evaluation and Testing), may be required to provide information on the effect of the discharge material on communities or populations of organisms expected to be exposed to it.

(f) Proposed disposal site determinations. (1) Each disposal site shall be specified through the application of these Guidelines. The mixing zone shall be confined to the smallest practicable zone within each specified disposal site that is consistent with the type of dispersion determined to be appropriate by the application of these Guidelines. In a few special cases under unique environmental conditions, where there is adequate justification to show that widespread dispersion by natural means will result in no significantly adverse environmental effects, the discharged material may be intended to be spread naturally in a very thin layer over a large area of the substrate rather than be contained within the disposal site.

(2) The permitting authority and the Regional Administrator shall consider the following factors in determining the acceptability of a proposed mixing zone:

(i) Depth of water at the disposal site;

(ii) Current velocity, direction, and variability at the disposal site;

(iii) Degree of turbulence;

(iv) Stratification attributable to causes such as obstructions, salinity or density profiles at the disposal site;

(v) Discharge vessel speed and direction, if appropriate;

(vi) Rate of discharge;

(vii) Ambient concentration of constituents of interest;

(viii) Dredged material characteristics, particularly concentrations of constituents, amount of material, type of material (sand, silt, clay, etc.) and settling velocities;

(ix) Number of discharge actions per unit of time;

(x) Other factors of the disposal site that affect the rates and patterns of mixing.

(g) Determination of cumulative effects on the aquatic ecosystem.

(1) Cumulative impacts are the changes in an aquatic

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ecosystem that are attributable to the collective effect of a number of individual discharges of dredged or fill material. Although the impact of a particular discharge may constitute a minor change in itself, the cumulative effect of numerous such piecemeal changes can result in a major impairment of the water resources and interfere with the productivity and water quality of existing aquatic ecosystems.

(2) Cumulative effects attributable to the discharge of dredged or fill material in waters of the United States should be predicted to the extent reasonable and practical. The permitting authority shall collect information and solicit information from other sources about the cumulative impacts on the aquatic ecosystem. This information shall be documented and considered during the decision-making process concerning the evaluation of individual permit applications, the issuance of a General permit, and monitoring and enforcement of existing permits.

(h) Determination of secondary effects on the aquatic ecosystem.

(1) Secondary effects are effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material. Information about secondary effects on aquatic ecosystems shall be considered prior to the time final section 404 action is taken by permitting authorities.

(2) Some examples of secondary effects on an aquatic ecosystem are fluctuating water levels in an impoundment and downstream associated with the operation of a dam, septic tank leaching and surface runoff from residential or commercial developments on fill, and leachate and runoff from a sanitary landfill located in waters of the U.S. Activities to be conducted on fast land created by the discharge of dredged or fill material in waters of the United States may have secondary impacts within those waters which should be considered in evaluating the impact of creating those fast lands.